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AUTHOR	Hofmeister, Alan M.
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ABSTRACT

This final report describes activities and accomplishments of a project which developed, implemented, and evaluated the effectiveness of a microcomputer/videodisc math instructional management system for grades K-4. The system was designed to operate on an APPLE II microcomputer, videodisc player, and input-output devices. It included three subsystems: (1) a math assessment subsystem; (2) a math instruction/management subsystem; and (3) a staff development subsystem. The system was developed to support diagnostic/prescriptive teaching for mastery learning. Evaluation of the system was conducted both with English-speaking and Spanish-speaking students. The assessment system was compared to a parallel paper and pencil criterion-referenced test. Additionally, student data were used to determine difficulty level, validity, and reliability of each item in the assessment component. Evaluation indicated the assessment component was valid and reliable and that the staff development procedures were effective. Appended are the teacher's guide to the math assessment videodisc program and a list of publications generated by the project. (DB)

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ED 409 686

Final Report

Development of a Microcomputer/Videodisc Aided Math Instructional Management System for Mildly Handicapped Children

Office of Special Education
Department of Education
Project #G008101536

Project Director:
Alan M. Hofmeister
Utah State University

1984

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Problem Statement

Introduction

Handicapped children being educated in our nation's schools today are legally entitled to educational services that are designed to meet their unique needs, according to the mandate provided by the Education for all Handicapped Children Act (P.L. 94-142). Within the law are specific requirements for:

1. Identification of learning needs of handicapped students through an objective and nondiscriminatory assessment process;
2. Development of a prescription, or plan, referred to as an Individual Education Program (IEP), based upon the objective assessment information;
3. Provision of "appropriate" instruction designed to specifically address identified learning needs; and
4. Evaluation of the student's performance to determine mastery and the need for adjustments in his/her IEP.

These requirements reflect the major components of an individualized instructional system.

Teachers who attempt to provide individualized programs of instruction must have the capacity to identify in a precise and timely fashion the individual learning needs of handicapped students. Assessment and instruction must be independent of potential interferences, such as a student's culture. Failure to acknowledge cultural factors frequently results in threats to the objectivity of both assessment and instruction. At times, assessment and instruction in this area should be independent of a student's reading ability, for it is at this level that basic concepts should be mastered and long-term attitudes formed (Papert, 1978). Once an assessment of a student's individual learning needs has been made and instruction has been initiated, evaluation of student performance should be initiated and carried out on a continual basis. The need for continual evaluation of student performance in an individualized program of instruction is essential to guarantee the student's progress within the program in a maximally efficient manner.

Attempts at individualizing instruction for handicapped students have met with mixed success. Two factors that appear to be related to ineffective assessment of individual needs appear to be:

1. The inability of current assessment and instructional procedures to accommodate students who are culturally different and come from different language backgrounds; and
2. The inadequacy of many assessment and instructional procedures in identifying specific instructional deficits and providing for their remediation.

Assessment procedures have frequently failed in assessing the learning needs of handicapped bilingual students (Mercer, 1977; Helms and Graeber, 1975; Alzate, 1975). Problems related to the objectivity of assessment and instruction not only affect bilingual handicapped students, but affect all handicapped children, regardless of ethnic origin or language background.

The inability of most individualized programs of instruction to produce data in a timely fashion represents another severe limitation in current programs. Evaluation of student performance and the reporting of data on an "as needed" basis could greatly facilitate the individualization process. Too frequently, however, performance data is only collected on a sporadic basis. In many situations, the lack of frequent data collection reduces the interactivity between student, teacher, and the instructional process. This results in static instructional programs that no longer address individual student needs. The collection of student performance data would enable a teacher to make modifications in instructional programs when it becomes apparent that existing instructional programs are not effective.

Criterion-referenced assessment techniques and the advent of new technology in the field of educational media offer potential solutions to the shortcomings of many current individualized instructional systems. The use of criterion-referenced assessment techniques can provide a relatively unbiased measure of academic performance when applied to a particular skill area. Glaser and Nitko (1971) defined a criterion-referenced test as one deliberately constructed to yield measurements that are directly interpretable in terms of specified performance standards. Alzate (1978), in indicating that cultural differences should be considered in test and instructional design and content, recommended that criterion-referenced tests be employed whenever possible to evaluate student performance in lieu of the more traditional but culturally biased, standardized, norm-referenced tests. In addition to their usefulness in reducing in part some of the more pervasive problems resulting from cultural differences, criterion-referenced assessment techniques also provide specific information that can be translated directly into instruction.

The emergence of instructional technology as a discipline has done much to ensure that assessment and instructional procedures function effectively. The U.S. Congressional Commission on Instructional Technology (1970) defined instructional technology as

> A systematic way of defining, carrying out and evaluating a total process of learning and testing in terms of specific objectives, based on research in human learning and communication and employing a combination of human and nonhuman resources to bring about more effective instruction. (p. 19)

Recently the random access videodisc and the microcomputer have been introduced as tools for instructional technologists. The random access videodisc, with its capacity to randomly access either of two audio tracks and one video track in presenting information, is far superior to its videotape predecessors. The use of microcomputers to address educational problems has steadily increased over the last five years. Sales of microcomputers for classroom use have dramatically increased in recent years. When combined with a random access videodisc, the microcomputer enables users to randomly access virtually thousands of combinations of both audio and video tracks. This arrangement offers the instructional technologist a very powerful tool for use in education.

This project modified and integrated an existing math instructional management system (i.e., the Goal-based Educational Management System, or GEMS), and microcomputer/videodisc (MC/VD) technology to produce an assessment and instructional management system free from many of the limitations previously mentioned.

Purpose

The purpose of the project was to develop, implement and evaluate the effectiveness of an MC/VD math instructional management system. The system included three subsystems:

1. A math assessment subsystem;
2. A math instruction/management subsystem; and
3. A staff development subsystem.

Each of these subsystems made extensive use of both microcomputer and videodisc technology. The scope for the proposed MC/VD math instructional management system included basic mathematic skills from Kindergarten through Grade 4. This content area was selected because of its appropriateness for students identified as learning disabled or mildly mentally retarded.

Approach

Hardware Components

The hardware components of the microcomputer/videodisc system consisted of a Discovision PR 7820 videodisc player, an APPLE II microcomputer with 64K of random access memory and two mini-floppy disc drives, a color television monitor, a graphics type printer, an input device enabling a user to interact with the videodisc and microcomputer, and an interface board that allowed the microcomputer to "communicate" with the videodisc.

Two microcomputer/videodisc systems, similar to that described above, have been developed previously as part of a project to provide computer-assisted instruction to mentally handicapped learners. These systems were adapted and used by the project. Videodisc development for the project involved the initial production of all assessment and staff development video content on videotape. This videotape content was field-tested with a random access videotape system.

Computer Software

The computer programs were written in the PASCAL computer language. PASCAL provided good editing capabilities, relatively fast execution speed, and the ability to utilize the full APPLE II microcomputer's graphic capabilities. Computer software necessary to control the videodisc had already been produced by another USU project. Computer software was required for math assessment, instructional management, and staff development. These programs underwent extensive field testing and revision during the 24 months of the project.

Criterion-Referenced Assessment and Curriculum

The initial set of items for the criterion-referenced test were taken from GEMS (Goal-based Education Management System). GEMS is an instructional management system that was developed and is presently being used by the Jordan School District in Northern Utah. The system was developed to support diagnostic/prescriptive teaching for mastery learning. The system has been very effective and has received national recognition. It was validated by the ESEA Title IV validation process in 1978, and was submitted to and approved by the Joint Dissemination Review Panel (JDRP) for national dissemination in 1979.

System Operation

The videodisc system operates by giving instructions and appropriate responses verbally to the learner. The instructions can be either English or Spanish, and the language can be selected programmatically. The system gives a command ("via audio") to the student such as "Which of the following sets are equal?" The video then illustrates options originating either from the videodisc or the microcomputer, whichever is most appropriate. Audio originates from one of the two audio tracks on the videodisc. The learner interacts with the system by manipulating an input device such as a keyboard, touch screen, or the remote control panel of the disc player. The learner's response to the instruction is recorded by the microcomputer, and the microcomputer sends the signal to the videodisc to advance to the next item or to select some other type of response that is appropriate to the learner's response.

For detailed information on system operation, the reader is referred to the Teacher's Guide to the Math Assessment Videodisc Program (see Appendix A).

Procedure

Project Objectives

The project had three major objectives. The first objective was the development of an interactive math assessment subsystem for grades K-4, utilizing a microcomputer controlled videodisc (MC/VD) system that could be used by learning disabled and mildly mentally retarded students and provided information to appropriately place students in a predefined math curriculum.

The second objective was the development of instructional management procedures compatible with the MC/VD math assessment subsystem. These procedures provided prescriptive, curricular and evaluative information regarding students to instructional decision makers, such as teachers and curriculum specialists.

The third objective was the design, implementation and evaluation of staff development procedures for potential users of the MC/VD math instructional system that provides for specific training of personnel.

Project Activities

The following is a listing of the major activities and associated tasks that were required to attain project objectives.

Activity: Design criterion referenced math assessment instrument for use on the microcomputer/videodisc system. This activity was primarily concerned with the adaptation of the existing GEMS placement tests for use on the microcomputer/videodisc. Construction of the criterion-referenced math assessment instrument focused on Grades K-4. The major focus of this activity was on assembling information, video materials, and audio materials. Also, identification and development of appropriate branching logic to guide development of computer software was necessary.

Specific tasks included:

1. Identification and sequencing of content material.
2. Preparation of branching logic.
3. Preparation of script and storyboard of instrument to use on the microcomputer/videodisc system.
4. The determination of the most appropriate response modes.
5. The use of a math assessment consultant to review script and storyboard for consistency with goals and objectives of the GEMS Proficiency Mathematics Program and math curricula in use in most classrooms.
6. Revision of the testing instrument, script and storyboard, based on the recommendations of the math assessment consultant.

Activity: Modify microcomputer/videodisc system hardware. The microcomputer/videodisc systems currently in use at Utah State University utilize a light interrupt touch panel for student response. Teachers may interact with the system through use of a keyboard. For the purposes of the proposed project, other student input devices were explored and interaction systems that allowed the videodisc player to be used without a microcomputer were developed. The remote control panel of the player was adapted for student input.

Activity: Produce a bilingual (Spanish/English) videotape for prototype. The bilingual version of the math assessment instrument was produced initially on 1/2-inch Beta videotape. This tape is used on random access videotape players. The system consisted of an industrial Sony 1/2-inch Beta videotape recorder/player, with a control unit interfaced to the APPLE II microcomputer. It was useful to develop a videotape prototype because tape may be erased and re-recorded upon. Once a videodisc has been pressed, it cannot be altered. By using the videotape prototype, evaluation of content and sequencing was facilitated, since changes were more easily made.

The tasks associated with this activity included:

1. Preparation of microcomputer software component to support the videotape prototype.
2. Preparation of graphic materials, as indicated in the prototype scripts.
3. Preparation of English narration on audio tape.
4. Preparation of Spanish narration on audio tape.
5. Assembling of audio tape and graphics on 1/2-inch videotape.
6. Integration of microcomputer software and videotape prototype.

Activity: Internal evaluation and field test of prototype videotape. The bilingual assessment prototype was evaluated by all members of the development team, one outside consultant, and students from the appropriate grade levels. Revisions were made based on the results of this evaluation. The results of all field testing are provided in the "Results" section of this report.

Activity: Produce interactive-videodisc with bilingual math assessment content. The videodisc was produced or "pressed" at Discovision Associates in Costa Mesa, California. All production prior to the pressing of the videodisc was accomplished at Utah State University facilities.

Tasks needed for this activity included:

1. Preparation of graphic materials, as indicated by the revised prototype scripts.
2. Production of two-track audio tape with revised Spanish narration on one track and revised English narration on the other.
3. Assembling of audio tape, graphics, and simulations on one-inch Helical scan, type C, videotape in USU's television studio.
4. Pressing of videodisc.

Activity: Field test math assessment subsystem in a school district. This field test was conducted in a large urban district (Davis School District) using elementary resource rooms. The field testing was conducted using random access videotape to simulate disc functions.

Tasks needed for this activity included:

1. Forms for observing teachers and students were developed.
2. The necessary parental permission was obtained.
3. Staff development training for the participating resource room teacher was provided. (See the teacher's manual in Appendix A for the curriculum used in the training.)
4. Pupils were selected and tested using the disc and Key Math.

On completion of the field test, the data from pupils, participating teachers, and content consultants were analyzed, and the content and supporting procedures were revised.

Activity: Conduct second field test. The revised content was field tested again locally with volunteer students. The main purpose was to provide additional student data on reliability and validity.

Results

The evaluation procedures had two major components. One was the ongoing review by consultants and the other the field testing with students.

Consultant Reviews

The consultants were involved to ensure (1) validity of math content, and (2) validity of Spanish translations. All these consultant activities were ongoing because the product was under constant revision during the length of the project. The senior math content consultant was Dr. Bryce Adkins, math specialist, Department of Elementary Education, Utah State University. Additional content information was also obtained from special education teachers involved in the field testing.

Four consultants were involved in assessing the validity of the Spanish translations. Two were concerned with the content and dialect issues and two conducted back translations after revisions were made.

Field Testing With Students

Two major field tests were conducted:

Field test 1: The first field test was conducted to evaluate the product in special education settings and collect concurrent validity information against a norm-referenced instrument. Evaluation of the staff development component was also a concern in this field test.

Field test 2: Extensive revisions were made following the first field test and the product was again field tested with students. The major purpose of the second field test was to collect additional reliability and validity data on the revised versions. In the second field test, concurrent validity data was collected using a criterion-referenced instrument as the criterion test.

The following data summaries include data from student evaluations as well as content reviewers.

Field Test 1: Data Summaries

The MVD videotape system was installed in two schools in the Davis School District. Placement was in elementary resource rooms. Testing began on April 21, at the Doxey site, and May 3, at the Hill Field site. A total of 30 English-speaking students were given the Math Assessment. During the testing, site evaluators noted no disruptive or aversive behaviors. Student response to the system was positive. No difficulty in student/system interaction was encountered. All presentation-related options were used in the testing (e.g., mode, repeats, etc.) and all performed well. During the testing the hardware system malfunctioned at times. The malfunctions did not seriously disrupt the testing.

Information was gathered on student test responses and anecdotal comments by teacher consultants and staff on individual items were also recorded. Upon completion of the Math Assessment, students were given the Key Math test. The Key Math was chosen because it is an individually administered test with a ceiling (three consecutive errors) which corresponds to the Math Assessment mode of administration. Table I lists the Math Assessment and Key Math scores. A high positive correlation was found between total percent correct on the two tests. Tables II and III include a scattergram of test results, correlations for each individual grade level, and for the total population.

Responses on 66 Math Assessment items which correspond to Key Math items were compiled. Responses were categorized as follows:

B = correct or incorrect on both tests

K = correct on Key Math, incorrect on MVD

M = correct on Math Assessment, incorrect on Key Math

Table IV shows this data.

Anecdotal data pertaining to individual items was also gathered in order to aid in identifying and revising poor items. Data was collected from site evaluators and from "in-house." This is summarized in Tables V and VI. Twenty items which were identified as potential "problem" items were compared to corresponding Key Math/MVD items which had "B" of less than 70 percent. This information is summarized in Table VII. Of those items, only four showed an inconsistent response pattern on the MVD/Key Math comparison.

Field Test 2: Data Summaries

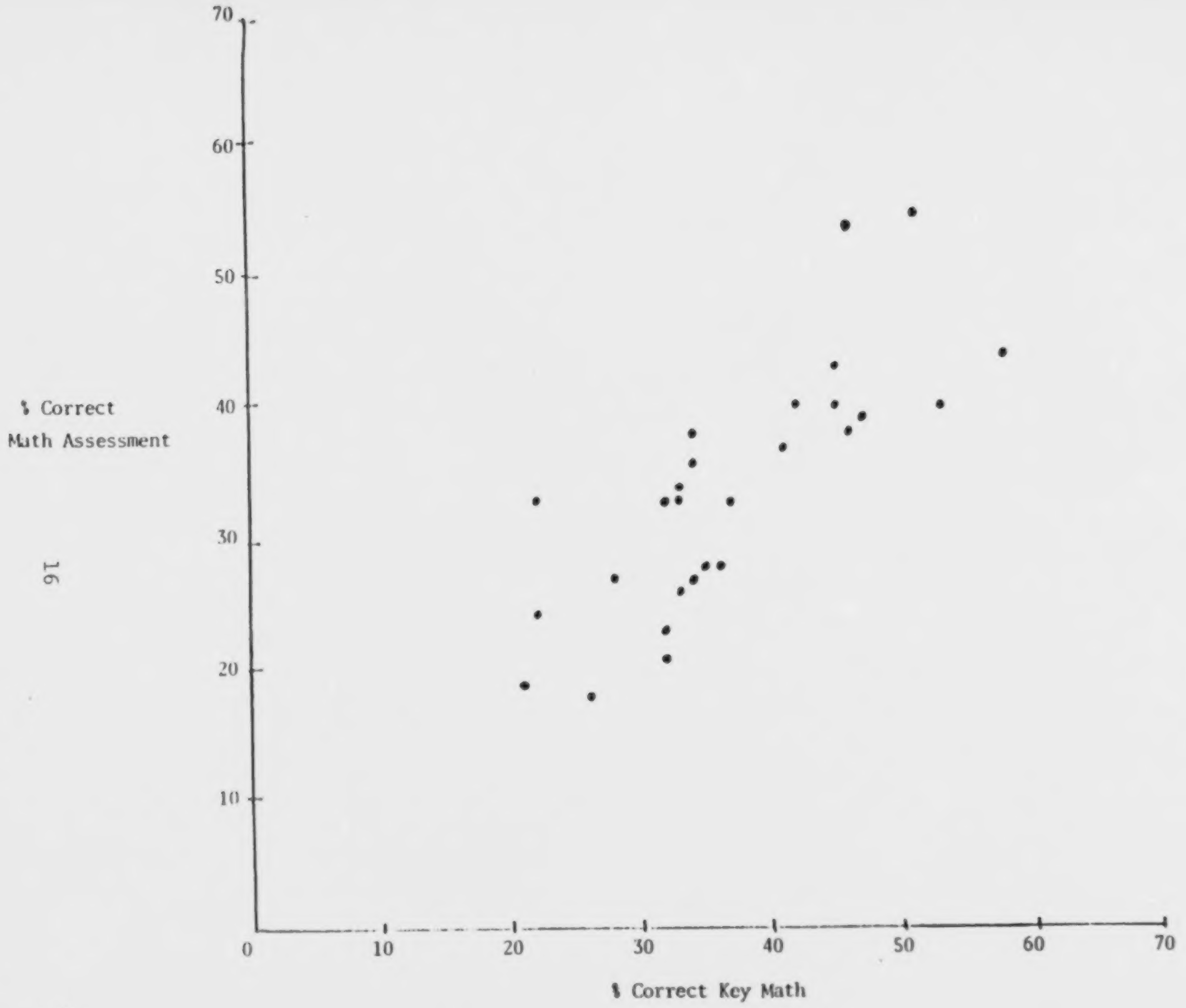
The second field test was conducted in-house. It was designed to evaluate the relationship beween the Math Assessment

Table I

MVD/Key Math % Correct

5/23/83 Student	% Correct MVD	% Correct KeyMath
H02	20	N/A
H11	41	N/A
P01	18	26
T06	19	21
T08	33	37
M07	34	33
R15	38	34
V09	28	36
M13	40	45
L12	40	53
M03	24	22
P04	26	33
O14	37	41
L16	39	47
T10	55	51
S05	27	34
M04	22	33
G05	54	46
D06	21	32
S11	44	58
O03	27	28
A14	28	35
K02	23	32
W01	36	37
A12	40	42
R13	43	45
W09	38	46
V08	34	N/A
B10	34	33
S07	33	32

Table II



% Correct
Math Assessment
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
% Correct Key Math

Table III

MVD - Key Math Correlations by Grade Level and Total Students

GRADE 1

N = 9
R = .90

GRADE 2

N = 7
R = .89

GRADE 3

N = 11
R = .71

TOTAL

N = 27
R = .82

MEAN % Correct Key Math 37.37

MEAN % Correct MVD 33.37

MVD SD = 9.01

Key Math SD = 9.54

Table IV MVD/Key Math Item Comparison

MVD Item	Total	% B	% M	% K
01/00/01/01	27	100	-	-
01/00/03/01	27	81	04	15
01/00/05/01	25	52	-	48
01/00/10/01	23	87	-	13
01/00/11/01	21	85	10	5
01/00/13/01	22	82	-	18
02/00/01/01	27	74	-	26
02/00/02/01	27	85	-	15
02/00/03/01	27	82	7	11
02/00/04/01	26	58	-	42
02/00/05/01	26	73	4	23
02/00/13/02	13	84	8	8
02/00/14/02	12	67	33	
02/01/01/01	27	86	7	7
02/01/04/01	27	60	7	33
02/01/05/01	27	72	14	14
02/01/09/02	14	36	28	36
02/01/10/02	11	45	36	19
02/01/19/03	3	-	33	67
02/02/04/01	24	54	16	30
02/02/45/03	2	50	50	-
02/02/47/03	2	-	-	100
02/03/01/01	26	58	38	4
02/03/02/01	20	65	30	5
02/03/04/02	14	79	21	-
02/03/11/03	3	67	33	-
02/03/17/04	-	-	-	-
02/03/18/04	-	-	-	-
02/03/20/04	-	-	-	-
02/04/09/03	8	75	25	-

Table IV

MVD Item	Total	% B	% M	% K
02/04/10/03	7	72	14	14
02/04/12/04	-	-	-	-
02/05/05/04	4	25	75	-
03/00/01/03	26	77	15	8
03/00/02/03	27	70	26	4
03/00/03/03	2	-	100	-
03/00/04/03	5	40	60	-
03/00/06/03	18	40	55	5
03/00/14/03	1	100	-	-
03/00/15/04	5	80	20	-
03/00/17/04	1	-	100	-
04/00/07/03	3	67	-	33
04/00/09/03	-	-	-	-
04/00/11/04	-	-	-	-
05/01/01/01	26	73	20	8
05/01/09/01	19	74	-	26
05/01/10/01	19	53	5	42
05/01/14/02	11	64	36	-
05/01/16/02	11	55	36	9
05/01/18/02	3	100	-	-
05/01/21/03	1	100	-	-
05/01/23/03	3	33	67	-
05/01/28/04	1	100	-	-
05/01/29/04	1	-	-	100
05/02/03/01	26	80	12	8
05/02/05/02	20	60	20	20
05/02/06/02	16	50	50	-
05/02/08/02	5	20	80	-
05/04/03/02	25	16	-	84
05/04/06/02	16	75	-	25

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Table IV

MVD Item	Total	% B	% M	% K
05/04/07/02	10	60	-	40
05/05/01/01	6	33	50	17
06/00/09/01	26	73	-	27
06/00/07/01	26	77	15	8
06/00/09/01	26	77	4	19
06/00/21/03	3	100	-	-

Table V

Anecdotal Item Feedback

ITEM	PROBLEM
1/0/2	Confusing graphic.
1/0/4	Use of ladder instead of answer box is confusing.
1/0/11	Students confused as to where to touch.
1/0/12	Students confused as to where to touch.
1/0/13	Problem for students with reversals and confusing as to where to touch.
1/0/18	Number line confusing. Too many numbers.
1/0/19	Number line confusing.
1/2/2	Audio confusing.
1/2/6	Problem for students with reversals.
2/0/4	Confusing graphic. Equation is incorrect.
2/0/10	Fish are hard to discriminate.
2/1/14	Confusing graphic.
2/1/7	Confusing graphic. No correct answer on screen.
2/2/14	Confusing graphic.
2/3/7	Confusing graphic.
2/3/8	Confusing graphic. Question unclear.
2/5/3	Confusing graphic.
4/0/1	Darken triangles to aid discrimination.
4/0/2	Graphic hard to see and count.
5/1/15	Misleading audio says equal to, less than, greater than - graphics are =
5/1/25	Garphic hard to read.
5/2/1	Answer boxes confusing.
5/2/2	Answer boxes confusing.
5/3/4	Garphic hard to read.
5/4/3	Not clear which is yardstick and which is ruler.
5/4/4	Audio says touch one half inch. That confuses students.
5/7/6	Confusing graphic. Students don't understand what to count. Should change color of meter sticks to be how many meters.

One problem unrelated to specific items is that of color blindness. If read and green items must be counted or differentiated it could cause problems for color blind students.

TOTAL = 27

Table VI

In House Item Feedback

ITEM	FEEDBACK
1/0/2	Poor distractor. Mitten has 3 stars.
1/0/4	Lack of answer box is confusing.
1/0/11	Omit boxes around stimulus numbers. Make them into number line.
1/0/12	Omit boxes around stimulus numbers. Make them into number line.
1/0/13	Omit boxes around stimulus numbers. Make them into number line. Potential for problem for students with reversals.
1/0/15	Make number larger or bolder.
1/0/16	Make number larger or bolder.
1/0/18	Number line confusing.
1/0/19	Don't stagger numbers in answer boxes.
1/0/22	Don't give number line, just have them touch correct box.
1/0/23	Don't give number line, just have them touch correct box.
1/1/3	Symbol order doesn't coincide with audio order.
1/1/4	Stimulus items should be clearer.
1/2/3	Make print bolder to highlight place values.
1/2/4	Add cue for concrete model.
1/2/5	Add cue for concrete model.
1/2/6	Add cue for concrete model.
1/2/8	Answer boxes too small. Highlight place values.
1/2/9	Answer boxes too small. Highlight place values.
1/2/10	Answer boxes too small.
1/2/12	Answer boxes too small.
1/2/14	Answer boxes too small, make print larger ot bolder.
1/2/15	Print in stimulus hard to read.

Table VI

ITEM	FEEDBACK
1/2/16	Answer boxes too small.
2/0/1	Two possible correct answers.
2/0/7	Stars should stand out more.
2/1/12	Very busy graphics should have audio cue to add across and down.
2/1/7	No correct answer.
2/2/2	Make difference in color more apparant.
2/2/3	Make difference in color more apparant.
2/2/9	Difficult to distinguish model.
2/3/2	Discrepancy between audio and graphic. Audio says barettes graphic shows dots.
2/3/7	Cross points hard to distinguish.
2/3/8	Model hard to read. Put dots further apart.
2/3/20	Use key word cues in Spanish and English.
2/3/21	Use key word cues in Spanish and English.
2/3/22	Use key word cues in Spanish and English.
2/3/23	Use key word cues in Spanish and English.
2/3/24	Use key word cues in Spanish and English.
2/3/25	Use key word cues in Spanish and English.
2/4/4	Eliminate wording on tickets.
2/4/7	Change color of stars to make them stand out more.
2/4/12	Put cues in English and Spanish. Eliminate word problem on screen.
3/0/7	Answer boxes too small.
4/0/1	Shade model sections to make clearer.
4/0/2	Answers difficult to read. They're too small.
4/0/4	Answers difficult to read. They're too small.
4/0/5	Make question clearer. Change color of 4 blocks.
5/0/4	Make toothpicks stand out more.

Table VI

ITEM	FEEDBACK
5/0/5	Make toothpicks stand out more.
5/0/11	Confusing graphic - simplify.
5/0/15	Audio says = < > Graphic shows = [illegible]
5/2/1	Make difference between minute hand and hour hand greater.
5/2/2	Make difference between minute hand and hour hand greater.
5/2/4	Make difference between minute hand and hour hand greater.
5/2/5	Make difference between minute hand and hour hand greater.
5/2/7	Make difference between minute hand and hour hand greater.
5/2/11	Make difference between minute hand and hour hand greater.
5/2/12	Make difference between minute hand and hour hand greater.
5/3/4	Make marks on thermometer clearer.
5/4/3	Hard to tell which is ruler and which is yardstick.
5/4/5	Pound or kilogram could both be correct.
5/7/6	Make meter sticks a different color so as not to be confused with sign.
5/8/8	Could be two correct answers.
6/0/13	Could be two correct answers.
6/0/19	Could be two correct answers.
7/0/8	Change envelope color to make stand out more.

TOTAL = 67

Table VII

Item with less than 70% Key Math correspondence and 5 or more responses	% Correspondence	IDENTIFIED ON ANCEDOTAL FEEDBACK (Y or N)
01/00/05/01	52	N
02/00/04/01	58	Y
02/00/14/02	67	N
02/01/04/01	60	N
02/01/09/02	36	N
02/01/10/02	45	N
02/02/04/01	54	N
02/03/01/01	58	N
02/03/02/01	65	Y
03/00/04/03	40	N
03/00/06/03	40	N
05/01/10/01	53	N
05/01/14/02	64	N
05/01/16/02	55	N
05/02/05/02	60	Y
05/02/06/02	50	N
05/02/08/02	20	N
05/04/03/02	16	Y
05/04/07/02	60	N
05/05/01/01	33	N

Videodisc and a parallel paper and pencil criterion-referenced test.

Items selected from the GEMS coincided one to one with Math Assessment Videodisc (MVD) items. The 389-item paper and pencil test was administered to a group of 34 students from June 28 to June 30. Students were tested in groups of approximately 10 students. Students selected for this study were those who responded to an advertisement in the local paper. All students selected were required to have finished first, second, or third grade. Students were paid $5 for completing both tests, so that students who did do both tests received a total of $10.

Testing with the videotape system was conducted by an administrator who was familiar with the MVD system and had worked with it in prior field tests. Students were trained to use the system, and were told what was expected of them. They were told that they were to go through the entire test. The test was administered in short sessions. Students were allowed a break in between. Actual testing time for the entire test would take about three hours with breaks.

Testing of students on the videotape system began July 18, and ended on August 5. Thirty-one students completed both the paper and pencil and the microcomputer/videodisc tests. During the MVD section of the test we noted no problem with students as far as interacting with the items or with the system. However, some problems were noted with fatigue and boredom due to the length of the session (also noted during the paper and pencil testing). Every effort was made to maintain the students' motivation level.

During the course of the testing the test administrator was keeping anecdotal records on any particular items that gave problems to the students and any particular changes that might be recommended based on student reaction to the items. At the conclusion of the field test, student and anecdotal data were collected.

The student data were analyzed using procedures explained in Educational Research (Borg and Gall, third edition, pages 233-236). Three statistics were derived for each item.

1. Difficulty index. Defined as the total percentage of correct answers for each question. A diffiuclty index was computed for each item.
2. Item validity. Defined as the correlation between subjects' response to a particular item and their scores on the criterion measure. It is derived by:
    a. Computing the score of each subject on the criterion measure.
    b. Selecting the 27 percent of the subjects who obtain the highest criterion score and the 27 percent who obtain the lowest criterion score.
    c. For each of the two groups, tallying the proportion who answer the first item on the MVD correctly.
    d. Using the proportions obtained, consulting a normalized biserial correlation table to determine the item-validity coefficient.
    e. Repeating steps 3 and 4 for each item.
3. Item reliability. Defined as the correlation between

subjects' responses to a particular item and their total test score. It is derived by:

a. Computing the score of each subject on the MVD.

b. Selecting 27 percent of the subjects who obtain the highest MVD score and the 27 percent who obtain the lowest MVD score.

c. For each of the two groups, tallying the proportion who answer the first item correctly.

d. Using the proportions obtained, consulting a normalized biserial correlation table to obtain item reliability coefficients.

e. Repeat steps 3 and 4 for each item.

The results of these can be found in Table VIII.

Using test data, anecdotal records, and the comments of Dr. Bryce Adkins (who served as content consultant for the project) certain items were targeted for deletion and revision. Also, based on these criteria, changes in curricular order were made. That is, items rearranged in the scope and sequence in order to be more appropriate as to item difficulty, and also to be more appropriate as to proper curricular sequence.

After all changes were made, the difficulty index for each item in each section was plotted. During this process it was noted that certain items had a difficulty index of 100 percent (every student answered correctly). These nondiscriminating items were closely examined. Some items which were entry level or kindergarten were retained as it was felt that all students in the study would normally have mastered these skills, and the items were necessary. Others were deemed poor items and were

Table VIII

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MVO Item #	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/01/00/01/01	97	100	87	.37	100	87	.37
M/01/00/02/01	84	87	50	.42	87	75	.19
M/01/00/03/01	100	100	100	0	100	100	0
M/01/00/04/01	100	100	100	0	100	100	0
M/01/00/05/01	81	100	50	.68	87	50	.42
M/01/00/06/01	100	100	100	0	100	100	0
M/01/00/07/01	100	100	100	0	100	100	0
M/01/00/08/01	97	100	87	.37	100	87	.37
M/01/00/09/01	100	100	100	0	100	100	0
M/01/00/10/01	97	100	100	0	100	100	0
M/01/00/11/01	100	100	100	0	100	100	0
M/01/00/12/01	87	100	62	.61	100	75	.51
M/01/00/13/01	84	100	62	.61	100	50	.68
M/01/00/14/01	68	100	50	.68	87	50	.42
M/01/00/15/01	90	100	75	.51	87	87	0
M/01/00/16/02	94	100	75	.51	100	87	.37
M/01/00/17/02	71	87	50	.50	100	62	.61
M/01/00/18/02	55	87	50	.50	87	50	.42
M/01/00/19/02	48	87	0	.84	75	0	.79
M/01/00/20/02	58	87	50	.42	100	50	.68
M/01/00/21/02	84	100	75	.51	87	75	.19
M/01/00/22/02	61	100	25	.79	100	50	.68
M/01/00/23/02	71	100	50	.68	87	75	.19
M/01/01/01/01	65	62	75	-.14	50	87	-.42
M/01/01/02/01	81	87	62	.07	87	87	0
M/01/01/03/01	58	75	37	.37	75	37	.37
M/01/01/04/01	58	87	12	.74	87	0	.84
M/01/01/05/01	55	75	37	.37	75	37	.37
M/01/01/06/01	48	62	12	.57	75	0	.79

M/D Item #	Difficulty Index	Validity Coefficient	Reliability Coefficient
M/01/01/07/01	81	.68	.68
M/01/01/09/01	68	.74	.84
M/01/01/10/01	52	.65	.79
M/01/01/11/01	74	.73	.79
M/01/02/01/01	98	0	.37
M/01/02/02/01	87	.51	.51
M/01/02/03/01	65	0	-.19
M/01/02/04/01	74	.61	.61
M/01/02/05/01	84	.68	.61
M/01/02/06/01	77	.68	.73
M/01/02/07/01	61	.60	.25
M/01/02/09/02	71	.68	.68
M/01/02/10/03	48	.98	.84
M/01/02/11/03	81	.73	.73
M/01/02/12/03	71	.73	.73
M/01/02/13/03	77	.73	.68
M/01/02/14/04	42	0	0
M/01/02/15/04	87	.51	.51
M/01/02/16/04	32	.68	.38
M/01/02/17/04	35	.57	.57
M/02/00/01/01	84	.68	.68
M/02/00/02/01	84	.61	.61
M/02/00/03/01	94	.37	.51
M/02/00/04/01	74	.73	.73
M/02/00/05/01	97	.37	.37
M/02/00/06/01	84	.61	.37
M/02/00/07/01	84	.61	.37
M/02/00/08/01	68	.31	.26
M/02/00/09/02	48	.79	.60

MVD Item #	Difficulty Index	Validity Coefficient	Reliability Coefficient
M/02/00/10/02	52	.60	.48
M/02/00/12/02	45	.48	.37
M/02/00/13/02	87	.51	.61
M/02/00/14/02	55	.26	.73
M/02/00/16/02	45	.65	.65
M/02/00/17/02	39	.26	.25
M/02/00/18/03	68	.79	.79
M/02/00/19/03	58	.86	.60
M/02/00/20/03	29	.57	.73
M/02/00/21/04	39	.25	.13
M/02/00/22/04	32	.48	.48
M/02/01/01/01	90	.37	.19
M/02/01/02/01	94	0	0
M/02/01/03/01	97	.37	.37
M/02/01/04/01	65	.73	.60
M/01/02/05/01	81	.73	.68
M/02/01/06/02	55	.68	.73
M/02/01/07/02	68	.31	.51
M/02/01/08/02	61	.51	.79
M/02/01/09/02	42	.48	.79
M/02/01/10/02	42	.48	.37
M/02/01/11/02	32	.26	.38
M/02/01/14/02	16	o	.30
M/02/01/15/02	31	.48	.57
M/02/01/16/03	61	.73	.86
M/02/01/18/03	35	.57	.57
M/02/01/19/03	26	.26	.26
M/02/01/20/03	23	.26	.48
M/02/01/21/03	27	-.65	-.37

MVD Item #	Difficulty Index	Validity Coefficient	Reliability Coefficient
M/02/01/22/04	16	0	0
M/02/01/23/04	25	0	-.14
M/02/02/01/01	77	.51	.51
M/02/02/02/01	68	.73	.73
M/02/02/03/01	61	.51	.79
M/02/02/04/01	77	.73	.73
M/02/02/05/01	74	.73	.73
M/02/02/06/01	81	.68	.42
M/02/02/07/01	77	.31	.37
M/02/02/10/01	68	.73	.79
M/02/02/11/01	68	.61	.42
M/02/02/12/01	68	.42	.60
M/02/02/13/01	94	.37	.51
M/02/02/15/01	68	.68	.61
M/02/02/16/01	87	.51	.61
M/02/02/17/01	52	.79	.86
M/02/02/18/01	84	.61	.68
M/02/02/19/01	71	.73	.68
M/02/02/20/01	61	.68	.73
M/02/02/21/01	77	.61	.68
M/02/02/22/01	68	.79	.79
M/02/02/23/01	71	.73	.73
M/02/02/24/01	45	.26	.13
M/02/02/25/01	74	.68	.68
M/02/02/26/01	77	.61	.51
M/02/02/27/01	87	.51	.31
M/02/02/28/01	48	.37	.74
M/02/02/29/02	71	.68	.79
M/02/02/30/02	58	-.65	-.37

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MVD Item #	Difficulty Index	Validity Coefficient	Reliability Coefficient
M/02/02/31/02	52	.79	.86
M/02/02/32/02	23	.79	.73
M/02/02/35/02	52	.13	.65
M/02/02/36/02	55	.13	.60
M/02/02/37/02	32	.48	.48
M/02/02/38/02	48	.26	.37
M/02/02/39/02	45	0	.48
M/02/02/40/02	26	.30	.30
M/02/02/41/02	52	.68	.48
M/02/02/42/02	48	.60	.74
M/02/02/45/02	55	.74	.79
M/02/02 46/02	50	.25	.37
M/02/02/47/02	19	.26	0
M/02/02/50/03	29	.57	.84
M/02/02/51/03	16	.26	0
M/02/02/52/04	23	0	.38
M/02/02/53/04	32	.73	.57
M/02/03/01/01	87	.37	.61
M/02/03/02/01	74	.61	.73
M/02/03/03/02	48	.48	.60
M/02/03/04/02	55	.79	.79
M/02/03/05/02	45	.86	.79
M/02/03/06/02	77	.61	.68
M/02/03/07/02	42	.86	.37
M/02/03/08/02	23	.48	.26
M/02/03/09/02	42	.86	.37
M/02/03/10/03	48	.73	.79
M/02/03/11/03	39	.79	.86
M/02/03/12/03	26	-.26	-.14

MVD Item #	Difficulty Index	Validity Coefficient	Reliability Coefficient
M/02/03/14/03	35	.74	.57
M/02/03/16/04	13	.30	.51
M/02/03/18/04	23	.14	0
M/02/03/19/04	32	-.14	.14
M/02/03/20/04	32	.65	.65
M/02/03/21/04	52	.86	.91
M/02/03/22/04	73	.79	.79
M/02/03/23/04	67	.51	.68
M/02/03/24/04	27	.68	.65
M/02/03/25/04	58	.48	.60
M/02/04/01/01	58	.60	.79
M/02/04/02/01	71	.31	.73
M/02/04/03/02	65	.51	.68
M/02/04/04/02	39	.57	.48
M/02/04/06/03	39	.26	.37
M/02/04/08/03	26	.14	-.26
M/02/04/09/03	29	-.14	0
M/02/04/10/03	32	-.57	-.26
M/02/04/11/04	16	-.38	-.38
M/02/04/12/04	26	0	0
M/02/05/01/03	42	.48	.48
M/02/05/02/03	45	.86	.65
M/02/05/03/04	23	.57	.26
M/02/05/04/04	39	.48	.48
M/02/05/05/04	35	0	-.26
M/03/00/01/03	84	.61	.61
M/03/00/02/03	97	.37	.37
M/03/00/03/03	68	.42	.73
M/03/00/04/03	84	.61	.31

MVD Item #	Difficulty Index	Validity Coefficient	Reliability Coefficient
M/03/00/05/03	68	.60	.74
M/03/00/06/03	52	.79	.79
M/03/00/07/03	52	.14	.13
M/03/00/08/03	32	-.26	.13
M/03/00/09/03	52	.86	.56
M/03/00/11/03	32	0	-.14
M/03/00/12/03	23	.38	.14
M/03/00/13/03	68	.86	.79
M/03/00/14/03	58	.51	.42
M/03/00/15/04	26	.48	.26
M/03/00/16/04	68	.31	.42
M/03/00/17/04	39	.25	.26
M/03/00/18/04	16	-.26	-.51
M/03/00/19/04	39	.37	.60
M/03/00/20/04	19	-.26	-.26
M/04/00/01/03	58	.51	.37
M/04/00/02/03	32	.42	.73
M/04/00/03/03	35	.73	.38
M/04/00/04/03	39	.74	.68
M/04/00/05/03	39	.48	.37
M/04/00/06/03	45	0	0
M/04/00/08/03	48	.86	.57
M/04/00/10/03	47	.60	.57
M/04/00/11/04	48	.60	.65
M/04/00/12/04	13	-.30	-.51
M/05/00/01/02	77	.68	.31
M/05/00/02/02	45	.37	.13
M/05/00/03/02	65	.42	.68
M/05/00/04/02	65	.86	.86

Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/05/00/05/02	42	62	12	.51	87	12	.74
M/05/00/06/03	55	87	12	.70	87	25	.60
M/05/00/07/03	61	100	37	.73	100	12	.86
M/05/00/08/03	58	87	37	.51	62	37	.25
M/05/00/09/04	42	37	37	0	50	37	.13
M/05/00/10/04	52	75	37	.37	75	12	.65
M/05/00/11/04	35	25	50	-.26	12	50	-.48
M/05/01/01/01	100	100	100	0	100	100	0
M/05/01/02/01	74	87	37	.51	87	25	.60
M/05/01/03/01	81	87	50	.42	100	37	.73
M/05/01/04/01	74	87	50	.42	87	37	.51
M/05/01/05/01	100	100	100	0	100	100	0
M/05/01/06/01	94	100	62	.61	100	75	.51
M/05/01/07/01	97	100	100	0	100	87	.37
M/05/01/08/01	90	100	75	.51	100	62	.61
M/05/01/09/01	71	100	25	.79	100	25	.79
M/05/01/10/01	65	87	25	.60	87	0	.84
M/05/01/11/01	77	100	37	.73	100	25	.79
M/05/01/12/02	81	100	62	.61	100	50	.68
M/05/01/13/02	90	100	87	.37	100	75	.51
M/05/01/14/02	68	100	50	.55	87	37	.51
M/05/01/15/02	74	87	25	.60	87	50	.42
M/05/01/16/02	68	100	25	.79	100	37	.73
M/05/01/17/02	39	75	25	.48	87	12	.74
M/05/01/18/02	52	62	25	.37	75	37	.37
M/05/01/19/03	52	75	25	.48	75	25	.48
M/05/01/20/03	68	87	52	.31	87	50	.42
M/05/01/21/03	19	0	25	-.51	25	37	-.14
M/05/01/22/03	87	87	100	-.37	100	100	0

Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/05/01/23/03	65	87	37	.51	87	37	.51
M/05/01/24/03	23	25	25	0	25	37	-.14
M/05/01/25/04	48	75	25	.48	75	12	.65
M/05/01/26/04	19	37	12	.38	50	12	.48
M/05/01/27/04	42	25	25	0	37	25	.14
M/05/01/28/04	26	25	25	0	12	12	0
M/05/01/29/04	26	62	0	.73	62	12	.57
M/05/02/01/01	52	62	37	.25	75	37	.37
M/05/02/02/01	55	62	37	.25	75	37	.37
M/05/02/03/01	77	87	50	.42	87	50	.42
M/05/02/04/02	90	100	62	.61	200	75	.51
M/05/02/05/02	65	87	25	.60	100	37	.73
M/05/02/06/02	52	87	25	.60	87	37	.51
M/05/02/07/02	39	75	25	.48	62	12	.52
M/05/02/08/02	65	87	62	.31	87	62	.31
M/05/02/09/02	19	25	12	.26	37	12	.38
M/05/02/10/03	68	87	25	.60	100	25	.79
M/05/02/11/03	58	87	50	.52	62	37	.25
M/05/02/12/04	26	50	12	.48	62	25	.37
M/05/02/13/04	42	62	15	.37	62	25	.37
M/05/02/14/04	55	62	62	0	62	62	0
M/05/03/01/03	90	100	62	.61	100	62	.61
M/05/03/02/03	84	100	75	.51	100	75	.51
M/05/03/03/03	10	12	0	.30	12	0	.30
M/05/03/04/04	23	37	12	.38	50	12	.48
M/05/03/06/04	52	50	37	.13	50	37	.13
M/05/03/08/04	48	50	25	.26	75	25	.48
M/05/04/01/01	90	100	75	.51	100	62	.61
M/05/04/02/01	71	87	25	.60	87	25	.60

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Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/05/04/03/02	45	0	50	-.68	25	62	-.37
M/05/04/04/02	23	50	0	.68	50	0	.68
M/05/04/05/02	94	100	87	.37	100	87	.37
M/05/04/06/02	94	100	75	.51	100	75	.51
M/05/04/07/02	55	50	50	0	75	37	.37
M/05/04/08/02	58	75	25	.48	87	25	.60
M/05/04/09/03	81	100	37	.73	100	50	.68
M/05/04/10/03	65	87	25	.60	87	25	.60
M/05/04/11/04	77	100	37	.73	100	25	.79
M/05/04/12/04	32	62	12	.57	62	12	.57
M/05/04/13/04	48	37	50	-.13	37	62	-.25
M/05/04/14/04	32	50	0	.68	50	12	.48
M/05/04/15/04	45	62	50	.13	62	50	.13
M/05/05/01/01	77	87	62	.31	100	62	.62
M/05/05/02/01	97	100	87	.37	100	87	.37
M/05/05/03/02	90	100	62	.61	100	62	.61
M/05/05/04/03	63	100	62	.61	87	62	.31
M/05/05/05/03	33	25	12	.26	37	0	.61
M/05/05/06/03	77	100	62	.61	87	62	.31
M/05/06/01/01	100	100	100	0	100	100	0
M/05/06/02/01	100	100	100	0	100	100	0
M/05/06/03/01	100	100	100	0	100	100	0
M/05/06/04/02	100	100	100	0	100	100	0
M/05/06/05/02	77	87	87	0	75	75	0
M/05/06/06/03	60	75	62	.14	87	50	.42
M/05/06/07/03	47	100	25	.79	75	25	.48
M/05/05/08/04	63	75	25	.48	87	12	.74
M/05/06/09/04	10	12	0	.30	0	0	0
M/05/06/10/04	30	62	0	.73	75	0	.79

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Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/05/06/11/04	60	75	62	.14	87	50	.42
M/05/07/01/01	61	75	25	.48	75	37	.37
M/05/07/02/02	81	100	50	.68	100	37	.73
M/05/07/03/02	97	100	87	.37	100	75	.51
M/05/07/04/02	97	100	87	.37	100	87	.37
M/05/07/05/02	100	100	100	0	100	100	0
M/05/07/06/02	61	75	37	.37	87	37	.51
M/05/07/07/03	39	62	62	0	75	50	.26
M/05/07/08/03	45	62	50	.13	50	50	0
M/05/07/09/03	3	12	0	.30	0	0	0
M/05/07/10/03	13	12	12	0	12	12	0
M/05/07/11/03	19	25	12	.26	37	12	.38
M/05/08/01/02	74	87	62	.31	87	50	.40
M/05/08/02/02	77	87	62	.31	87	62	.31
M/05/08/03/02	81	87	37	.51	100	50	.68
M/05/08/04/03	45	75	25	.48	75	37	.37
M/05/08/05/03	87	100	75	.51	100	75	.51
M/05/08/06/03	42	75	25	.48	75	25	.48
M/05/08/07/03	48	75	25	.48	75	37	.37
M/05/08/08/03	42	37	25	.14	87	37	.50
M/05/08/09/03	29	62	37	.25	50	25	.26
M/05/08/10/03	48	62	52	0	75	50	.26
M/05/08/11/04	74	87	50	.42	87	62	.31
M/05/08/12/04	65	62	50	.13	75	37	.37
M/05/08/13/04	84	87	62	.31	100	50	.68
M/05/08/14/04	48	75	25	.48	87	25	.60
M/05/08/15/04	13	12	0	.30	0	25	-.51
M/05/08/16/04	42	62	12	.57	75	25	.48
M/06/00/01/01	97	100	87	.37	100	87	.37

Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/06/00/02/01	100	100	100	0	100	100	0
M/06/00/03/01	97	100	100	0	87	100	-.37
M/06/00/04/01	100	100	100	0	100	100	0
M/06/00/05/01	97	100	87	.37	100	100	0
M/06/00/06/01	87	87	87	0	87	75	.19
M/06/00/07/01	97	100	100	0	100	100	0
M/06/00/08/01	100	100	100	0	100	100	0
M/06/00/09/01	94	87	87	0	100	100	0
M/06/00/10/01	87	100	62	.61	100	62	.61
M/06/00/11/01	97	100	87	.37	100	87	.37
M/06/00/12/01	94	100	87	.37	100	87	.37
M/06/00/13/01	65	87	37	.51	87	37	.51
M/06/00/14/01	94	100	75	.51	100	87	.37
M/06/00/15/01	74	75	50	.26	100	62	.61
M/06/00/16/02	58	87	25	.60	62	50	.13
M/06/00/17/02	42	37	12	.38	62	0	.73
M/06/00/18/02	35	75	25	.48	62	12	.57
M/06/00/19/02	45	50	12	.48	50	25	.26
M/06/00/20/03	13	25	0	.51	25	12	.26
M/06/00/21/03	13	25	12	.26	25	12	.26
M/06/00/22/03	39	62	25	.37	62	25	.37
M/06/00/23/03	68	87	37	.51	87	37	.51
M/06/00/24/03	71	87	62	.31	87	50	.42
M/06/00/25/03	39	12	37	-.38	50	37	.13
M/06/00/26/03	35	37	25	.38	37	25	.38
M/06/00/27/03	87	75	87	-.19	87	100	-.37
M/06/00/28/03	35	37	25	.38	62	37	.25
M/06/01/01/03	87	87	87	0	87	87	0
M/06/01/02/03	100	100	100	0	100	100	0

Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/06/01/03/03	94	100	100	0	100	75	.51
M/06/01/04/03	94	100	75	.51	100	75	.51
M/06/01/05/03	68	62	37	.25	87	62	.31
M/06/01/06/03	55	75	37	.37	100	37	.73
M/06/01/07/03	77	87	50	.42	100	37	.73
M/06/01/08/03	42	37	37	0	37	37	0
M/06/01/09/03	45	37	37	0	62	37	.25
M/06/02/01/03	84	100	50	.68	87	62	.31
M/06/02/02/03	84	100	50	.68	100	62	.61
M/06/02/03/03	74	87	50	.42	100	62	.61
M/06/02/04/03	23	75	0	.79	50	0	.68
M/06/02/05/03	68	75	37	.37	62	62	0
M/06/02/06/03	100	100	100	0	100	100	0
M/07/00/01/02	58	87	50	.42	75	37	.37
M/07/00/02/02	68	100	12	.86	100	25	.79
M/07/00/03/02	77	87	87	0	87	62	.31
M/07/00/04/03	84	87	62	.31	87	62	.31
M/07/00/05/03	74	87	50	.42	100	50	.68
M/07/00/06/03	68	87	37	.51	100	37	.73
M/07/00/07/04	19	37	12	.38	37	25	.38
M/07/00/08/04	45	87	12	.74	100	12	.86
M/07/00/09/04	90	87	87	0	87	75	.19
M/07/01/01/03	71	100	12	.86	100	12	.86
M/07/01/02/03	58	100	0	.91	100	0	.91
M/07/01/03/03	58	100	0	.91	87	0	.84
M/07/02/01/03	81	100	25	.79	100	37	.73
M/07/02/02/03	58	100	12	.86	100	25	.79
M/07/02/03/03	58	75	12	.65	75	37	.37
M/07/03/01/03	16	75	12	.65	75	37	.37

Item	Difficulty Index	Validity Coefficient			Reliability Coefficient		
M/07/03/02/03	19	25	37	.38	12	25	-.26
M/07/03/03/03	19	12	12	0	12	0	.30
M/07/03/04/03	23	12	12	0	25	0	.51
M/07/03/05/04	45	75	12	.65	87	0	.84
M/07/03/06/04	61	100	62	.61	100	37	.73
M/07/03/07/04	29	37	37	0	50	37	.13

deleted on the grounds that all students would not normally have mastered the skills involved and the item was not measuring the desired skill.

A correlation of .92 was obtained between GEMS paper and pencil test and the microcomputer/videodisc test, based on the total percent correct on the entire test. After items were deleted (54 items were deleted), a second correlation was run using only retained items, and a correlation of .91 was obtained.

Individual sections of the test were also correlated to the GEMS. The correlation was based on the total correct per item. Individual coefficients for sections ranged from +.99 to -.08 (see Table IX). The section obtaining the correlation of -.08 was examined and an unintended ambiguity was discovered and corrected by revising the items of the section.

Since the test was administered only to native English speakers, it was necessary to ascertain that the test would also be appropriate for Spanish-speaking populations. To ensure this, each modification in the test was back translated. In all, three back translations of the test were performed. Back translations were performed by translators whose primary language was English and had learned Spanish in the home from parents whose primary language was Spanish.

Conclusions

The comparatively high correlation (r=.82) on the first field test with Key Math in a special education environment and the comparatively high correlation (r=.92) with another criterion-referenced test on the second field test indicate that:

Table IX

CORRELATION OF TOTAL CORRECT PER ITEM PER SECTION MVD/GEMS

Strand/Section	r
1/0	.66
1/1	.53
1/2	.54
2/0	.70
2/1	.84
2/2	.48
2/3	.50
2/4	.84
2/5	.42
3/0	.25
4/0	-.08
5/0	.91
5/1	.68
5/2	.68
5/3	.92
5/4	.60
5/5	.60
5/6	.37
5/7	.70
5/8	.48
6/0	.77
6/1	.96
6/2	.92
7/0	.52
7/1	.99
7/2	.97
7/3	.83

1. A reliable and valid instrument has been developed, and
2. The staff development procedures used to train special education personnel were effective.

Project Outcomes

1. Copies of the finished videodiscs and supporting software and print materials are now available for the cost of reproduction from Utah State University.
2. The field has been provided with the first special education bilingual assessment demonstration using interactive videodisc technology.
3. Contributions to the literature have been made in the following areas:
    a. In instructional design the experience with the project was responsible for some of the ideas that appeared in "Microcomputers in Special Education: Implications for Instructional Design," Exceptional Education Quarterly, by Alan Hofmeister (see Appendix B).
    b. Additions and refinements were made to the authoring of interactive video instruction for the mentally retarded. This information was reported in "Interactive Video Authoring of Instruction for the Mentally Handicapped," Exceptional Education Quarterly, by Ron Thorkildsen and Alan Hofmeister (see Appendix B).
    c. The practitioner literature was augmented with information on the project. This information was included in the following articles by project staff:

"The Interactive Videodisc for Special Education Project: Providing CAI for the Mentally Retarded," The Computing Teacher, by Ron Thorkildsen, Kim Allard and Bob Reid, and "Math Assessment Videodisc Program," for submission to The Computing Teacher, by Dan Eastmond (see Appendix B).

d. The disc is still being used as a research tool. The most recent USU effort involved the dissertation "The Influence of Test Administration Language on the Math Test Scores of Bilingual Hispanic Children" (see Appendix B). The data collection phase of the study is complete. The study was done in cooperation with the Special Education Department at New Mexico State University.

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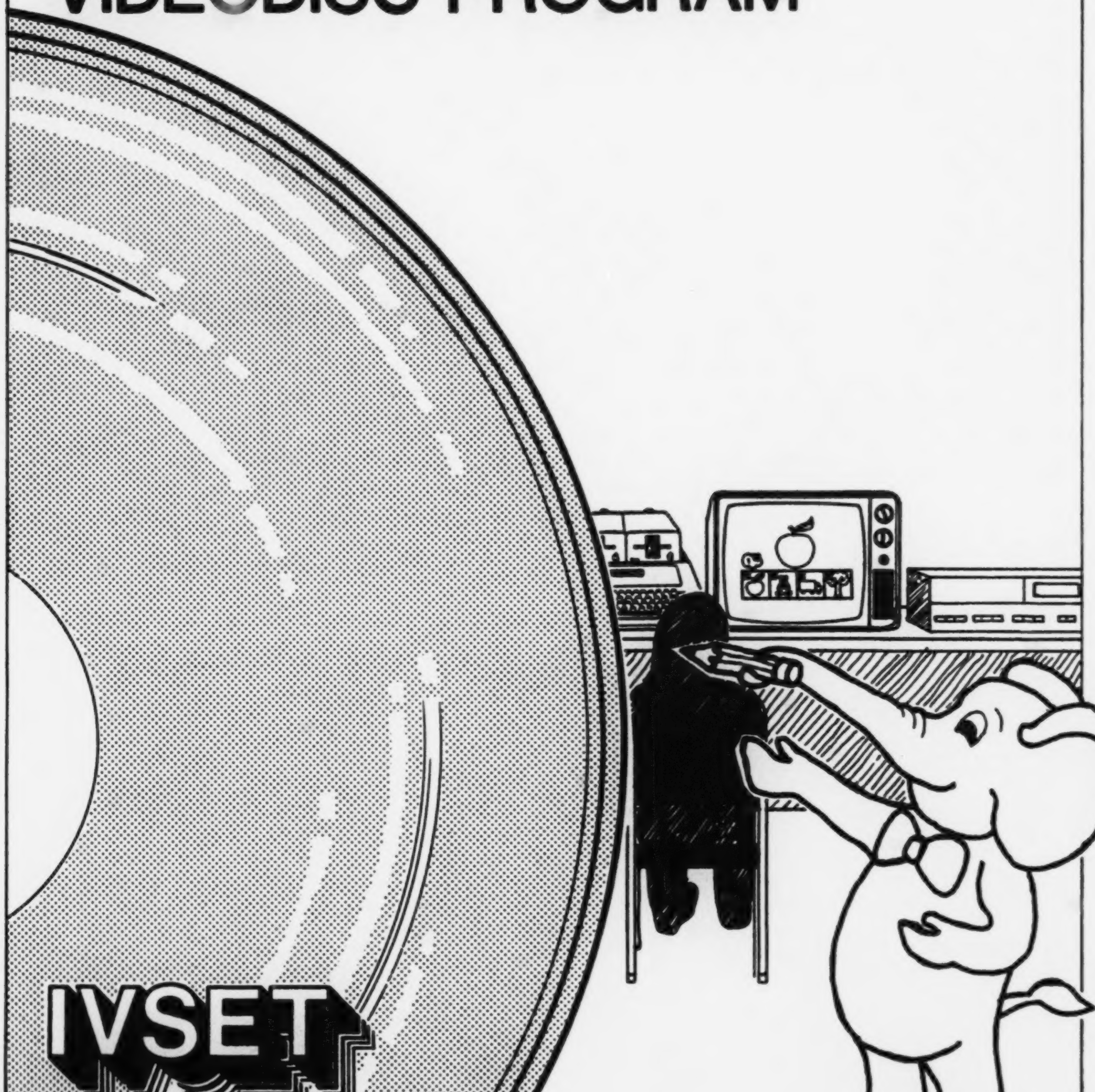
Appendix A

Teacher's Guide to the Math Assessment Videodisc Program

TEACHER'S GUIDE TO THE MATH ASSESSMENT VIDEODISC PROGRAM



IVSET

1983

VERSION A

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TEACHER'S GUIDE
to the
MATH ASSESSMENT VIDEODISC PROGRAM

VERSION A

Prepared by:

Kim E. Allard
Project Coordinator
&
Bob Reid
Instructional Designer

Project Directors:

Alan Hofmeister
Ron Thorkildsen

IVSET Project
Exceptional Child Center
UMC 68
Utah State University
Logan,Utah 84322

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This document is a release of the INTERACTIVE VIDEODISC FOR SPECIAL EDUCATION TECHNOLOGY (IVSET) project at Utah State University's Exceptional Child Center. Funds for the development of this document and the MATH ASSESSMENT VIDEODISC PROGRAM were provided by the Office of Special Education, Department of Education, Project #G008101536. This document does not reflect the policy or position of the Office of Special Education nor should any official endorsement be implied.

Math Assessment Videodisc Program
Teacher's Guide
Version A

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I. OVERVIEW OF MATH VIDEODISC PROGRAM

A. Materials and Equipment Required

The IVSET MATH ASSESSMENT program is designed to assess a student's mastery of 335 objectives ranging in difficulty from first to fourth grade level. The test can be administered in either English or Spanish depending upon student needs. No reading skills are required. The test can be administered independently or with supervision. The assessment is suitable for use as both a screening and diagnostic tool. Test scoring and record keeping are performed automatically. A full range of reports, describing student progress and areas of strengths and weaknesses are available for all students tested.

To use the IVSET Math Assessment Videodisc Program you should have the following:

1. Materials

A functional interactive videodisc system as described in Appendix A.

2. Equipment

IVSET FORMATTER diskette

MATH ASSESSMENT PROGRAM DISKETTE #1

MATH ASSESSMENT PROGRAM DISKETTE #2

MATH ASSESSMENT MANAGEMENT DISKETTE

MATH ASSESSMENT Videodisc

SCRATCH PAPER & PENCIL

B. Prerequisite Skills

The following prerequisite skills are necessary for the student to be successfully assessed using the IVSET MATH ASSESSMENT Videodisc program.

COGNITIVE

The student must be able to understand spoken directions, in either English or Spanish at first grade listening comprehension.

BEHAVIORAL

The student must be able to attend to task for 10-20 consecutive minutes.

READING

The student must be able to recognize the letters A, B, C and D in printed form.

PERCEPTUAL/MOTOR

1. The student must be able to perceive figures and/or numbers visually on television screen.
2. The student must be able to indicate a selected response by:
    a. Selecting a letter orally.
    b. Selecting a letter by touching an area 1/2" square on a television screen.

C. Overview of Scope and Sequence

1. Strand/Section/Objective Design

The curriculum of the IVSET MATH ASSESSMENT program covers seven main areas. They are:

1. NUMERATION
2. WHOLE NUMBERS
3. FRACTIONS
4. DECIMALS
5. MEASUREMENT
6. GEOMETRY
7. GRAPHING/PREDICTION

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Each of these areas is called a "STRAND". Each STRAND consists of related objectives which are organized in ascending order of difficulty from 1st to 4th grade level. Each STRAND is numbered. The number beside each of the STRANDS listed above is the number by which we refer to the STRAND (e.g., STRAND 3 is FRACTIONS; STRAND 4 is DECIMALS, etc.)

Most STRANDS cover a broad curriculum area. In order to further refine the curriculum, STRANDS are divided into SECTIONS. SECTIONS are groups of closely related objectives.

A STRAND may have several SECTIONS or only one. For example, STRAND 1 (NUMERATION) contains three SECTIONS. (See below)

STRAND	SECTIONS
1. NUMERATION	0. NUMBER RECOGNITION
	1. GREATER THAN, LESS THAN
	2. PLACE VALUE

Each SECTION is divided into related OBJECTIVES. The OBJECTIVES are what is tested by the actual test items themselves. Here is an example:

STRAND 7	SECTION 1	OBJECTIVES
Graphing & Prediction	Bar Graphs	1. Interpret information on a bar graph.
		2. Compare information on a bar graph.
		3. Order information on a bar graph.

As shown above, STRAND 7, SECTION 1 consists of three OBJECTIVES. As you can see, the OBJECTIVE level is the most detailed level. We have gone from a broad skill area (STRAND) to more closely related skill areas (SECTION) to the actual skills themselves (OBJECTIVES).

2. Question Numbering

Each test item in the math asessment progam has been coded as to STRAND/SECTION/OBJECTIVE/GRADE LEVEL. Each code item is identified by a four part-eight digit code number. We'll use the previous example to show how test items can be identified by the item coding system. Let's look at the code for the objective which requires the student to "Compare information on a bar graph". This objective can be found in SECTION 1 of STRAND 7. Given this information our code for the item is:

07	01	02	03
Strand	Section	Objective	Grade Level

Note that the last two digits to the right of the code provide information on the grade level of the item.

Here is one for you to decode. Determine the STRAND, SECTION, OBJECTIVE and GRADE LEVEL of this test item before reading on.

05/02/06/02

ANSWER: This item is in STRAND 5 (MEASUREMENT), SECTION 2. It is the 6th OBJECTIVE in SECTION 2 and is a GRADE 2 level objective. To find out exactly what this test item is measuring, you must refer to the MATH ASSESSMENT SCOPE AND SEQUENCE located in Appendix C. The 6th OBJECTIVE in SECTION 2 of STRAND 5 requires the student to "Identify five minute intervals". With little practice you should have no trouble determining the skill which is tested by each item. You will find this particularly important as you interpret the results of each student's assessment.

II. USING THE IVSET MATH ASSESSMENT PROGRAM WITH STUDENTS

A. Training for Assessment

Before administering the IVSET MATH ASSESSMENT it is important the student is aware of what s/he will be expected to do and is prepared to properly interact with the microcomputer/videodisc system. To accomplish this, a training script has been included in Appendix D.

We recommend that each student's first experience with the MATH ASSESSMENT PROGRAM be the training program. This will ensure a positive first experience with the microcomputer/videodisc system and an accurate assessment. It is very important that students have a clear understanding of how to answer questions, how to repeat a question, etc. Failure to properly train students may result in invalid test results.

The training program will take approximately 10-15 minutes to complete. The script for the training program can be found in Appendix D.

B. English/Spanish Selection

The IVSET Math Assessment allows students to be tested in either English or Spanish. The selection of which language will be used for testing is made when students are first signed onto the program. The language used can be changed, if in the teacher's judgement the language originally selected is inappropriate.

See Change Student Information p. **32**

C. Length of Sessions

The time necessary to administer the IVSET MATH ASSESSMENT will depend primarily on the student's mathematical ability level. Approximate times are shown below.

FUNCTIONAL LEVEL	TESTING TIME
GRADE 1	1 1/2 hours
GRADE 2	2 1/2 hours
GRADE 3	4 hours

Because of the time necessary to complete the assessment, it is recommended that the test not be administered in one session. Rather, testing should be broken into short sessions (10-15 minutes total) which are commensurate with student's attention span. Since this can vary widely between students, it is impossible to give an optimum session length. If a student begins to appear fatigued or his/her attention wanders, end the session or give the student a break, and resume testing later.

D. Testing Strategies

The IVSET MATH ASSESSMENT can be used to determine functional gains (or losses), and to diagnose skill deficiences. If administered as a pre and post test it will be possible to determine each student's gains (or losses) in terms of objectives mastered and percent of mastery by grade level. When used as a diagnostic tool, student competencies can be identified on an ongoing basis for prescriptive teaching. In practice, you will find many uses for the assessment.

Students can use the system without supervision (after appropriate training) although it is advisable to monitor the initial assessment. For some students it may be advisable to supervise all sessions to ensure that the student is attending to task and is putting forth his/her best effort. This can be done by an aide or a peer tutor. If diagnostic information is desired, it is recommended that the student test session(s) be monitored by the teacher, as observation of the student's behaviors during the assessment can yield valuable and pertinent additional information.

E. Test Presentation

The IVSET MATH ASSESSMENT can be presented a full STRAND at a time or by the SECTION. When the student's testing session begins, you will be given this option. Test item presentation begins with the first item in the STRAND or SECTION and continues until either the STRAND or SECTION is completed or the student makes three consecutive incorrect responses.

This ceiling has been included in the assessment to maximize time efficiency and minimize student frustration. When the ceiling is reached, the program will advance to the next SECTION if you are testing a STRAND. If you are testing a SECTION at a time, the program will return to the menu at which you can select another SECTION or end the test.

If necessary, students can have a question repeated by pressing the space bar. A question may be repeated only once. The time limit for each question is 90 seconds. If the student has not responded after 60 seconds the computer will "beep" to prompt him/her to respond. If 90 seconds elapse without a response the item will be scored as incorrect and the next question will be presented.

F. Tips on Administration

1. Prior to Testing

Select an environment free from distractions. Be sure to provide sufficient work space for students to use paper and pencil for scratch. Arrange the system with work space directly in front of the television so that the student can easily shift attention from paper and pencil to screen. The student should be able to easily reach the screen and the space bar on the computer. Paper and pencil should be placed directly in front of the student prior to the start of the session. Otherwise students may not remember they may use them.

2. During Testing

Because the IVSET MATH ASSESSMENT uses a touch screen to record student responses care should be taken to ensure that the student touches correctly. Some students have difficulty remembering to use a single finger to touch the answer boxes. "Dangling fingers" can result in incorrect responses being recorded. For these students, the use of a "pointer" (e.g., a pencil with a large eraser) may be advisable. Students with small fingers can sometimes touch an answer box without any response. If this happens tell the student to wiggle his/her finger. Some items require the student to count objects on the screen. Many students will actually touch the items on the screen while counting. This is permissable, but the student should be reminded to be careful to keep his/her finger away from the answer boxes to prevent accidental entry of a response.

III. RECORD KEEPING AND REPORTS

A. Interpreting Reports

The IVSET MATH ASSESSMENT PROGRAM offers the teacher four different reports on student performance. Each report gives the teacher information on a different facet of a student's assessment results. The combination of the four reports provides the teacher with a comprehensive overview of a student's mastery of the curricula.

The four reports are:

1. OBJECTIVE MASTERY REPORT
2. STUDENT SUMMARY REPORT
3. ERROR ANALYSIS REPORT
4. STUDENT PROGRESS GRAPH

The following sections explain how to read and interpret each report.

1. Objective Mastery Report

This report is designed to provide the teacher with a detailed record of a student's performance on a specified SECTION and/or STRAND.

The OBJECTIVE MASTERY REPORT, as the name suggests, gives information on each OBJECTIVE in the SECTION selected.

Let's look at a sample OBJECTIVE MASTERY REPORT to see how it should be read. At the top of the report you see:

1. The STUDENT NAME
2. The DATE the report was printed
3. The LANGUAGE the test was administered in
4. The STRAND and SECTION the report reflects
5. The percentage of CORRECT answers the student achieved in the SECTION.
6. The DATE the assessment was given

Below the student information are four columns labelled:

OBJECTIVE	CORRECT ANSWER	STUDENT'S ANSWER	TEACHER NOTES

The column labelled OBJECTIVE contains the codes for each test item in the selected STRAND and SECTION. In our example we've used STRAND 1, SECTION 0. All twenty-three items of the SECTION are listed in code form in this column.

The next column, labelled CORRECT ANSWER, indicates the correct response for each item. In our sample report, the correct response to the first item is C, the second is B, etc. The correct ANSWER for each item in the SECTION is included in this column.

The third column labelled STUDENT ANSWER gives you two pieces of information. In our sample OBJECTIVE MASTERY REPORT the first listing in this column is:

C CORRECT

The letter C is the student's response to the item, since the ANSWER (shown in column 2) is also C the response was scored CORRECT. On our sample report notice that items 1 through 11 were scored as CORRECT. Items 12, 13, 19 and 20 were scored as INCORRECT. Notice that item 18 has *NO RESPONSE as the STUDENT ANSWER. This occurs only when the student fails to respond to an item before the 90 second time limit is reached.

```
************************************************************************************************

                            OBJECTIVE MASTERY REPORT

************************************************************************************************
          STUDENT NAME:                                       CORRECT %:  70
          DATE:  6/22/83
          LANGUAGE:  ENGLISH
          STRAND NUMBER:  1  SECTION NUMBER:  0
------------------------------------------------------------------------------------------------
                             CORRECT         STUDENT
          OBJECTIVE          ANSWER          ANSWER             TEACHER NOTES:
------------------------------------------------------------------------------------------------

          01/00/01/01          C             C  CORRECT
          01/00/02/01          B             B  CORRECT
          01/00/03/01          D             D  CORRECT
          01/00/04/01          D             D  CORRECT
          01/00/05/01          C             C  CORRECT
          01/00/06/01          C             C  CORRECT
          01/00/07/01          B             B  CORRECT
          01/00/08/01          B             B  CORRECT
          01/00/09/10          B             B  CORRECT
          01/00/10/01          D             D  CORRECT
          01/00/11/01          C             C  CORRECT
          01/00/12/01          D             C  INCORRECT
          01/00/13/01          D             A  INCORRECT
          01/00/14/01          C             C  CORRECT
          01/00/15/01          C             C  CORRECT
          01/00/16/01          B             B  CORRECT
          01/00/17/02          B             B  CORRECT
          01/00/18/02          A             *  NO RESPONSE
          01/00/19/02          A             C  INCORRECT
          01/00/20/02          C             A  INCORRECT
          01/00/21/02          A             *  UNATTEMPTED
          01/00/22/02          A             *  UNATTEMPTED
          01/00/23/02          C             *  UNATTEMPTED
------------------------------------------------------------------------------------------------

                            OBJECTIVES TO BE MASTERED
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

                        STRAND NUMBER 1  SECTION NUMBER 0
                        OBJECTIVE                           (IC) INCORRECT ON ASSESSMENT
                                                            (UA) UNATTEMPTED ON ASSESSMENT
                                                            (NR) NO RESPONSE

------------------------------------------------------------------------------------------------
     LEVEL 1
   01/00/12/01     IDENTIFY NUMERALS FROM 0 TO 60 IN SEQUENCE          (IC)
   01/00/13/01     IDENTIFY NUMERALS FROM 1 TO 100 IN SEQUENCE         (IC)

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     LEVEL 2
   01/00/18/02     IDENTIFY PATTERNS OF 100'S                          (NR)
   01/00/19/02     IDENTIFY PATTERNS OF 10'S                           (IC)
   01/00/20/02     IDENTIFY PATTERNS OF 5'S                            (IC)
   01/00/21/02     IDENTIFY PATTERNS OF 2'S                            (UA)
   01/00/22/02     IDENTIFY PATTERNS OF ODD NUMBERS                    (UA)
   01/00/23/02     IDENTIFY PATTERNS OF EVEN NUMBERS                   (UA)
```

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In our sample the student answered items 18, 19 and 20 incorrectly, so no further items in the SECTION were presented and all the following items in the SECTION were scored * UNATTEMPTED.

The fourth column is labelled:

TEACHER NOTES

This space is reserved for your comments. Possible uses of the column include:

1. An error may occur in testing. A student could enter an answer accidentally or carelessly which could cause an item's score not to reflect the student's ability.

2. You may possess information from other sources that contradicts the results of the test.

This space is provided to indicate events of this nature. It allows you to take into account sources other than the IVSET MATH ASSESSMENT to create a more meaningful picture of a student's ability.

The second section of the OBJECTIVE MASTERY REPORT is OBJECTIVES TO BE MASTERED. This section lists all those items scored as INCORRECT

There are two columns in this section.

OBJECTIVE (IC) INCORRECT ON ASSESSMENT
(UA) UNATTEMPTED ON ASSESSMENT
(NR) NO RESPONSE

The OBJECTIVE column contains the code number of each item scored INCORRECT and a brief description of the corresponding objective. This serves as a handy reference to the user. The next column indicates whether the item was missed, (IC) INCORRECT ON ASSESSMENT; whether it was not responded to, (NR) NO RESPONSE; or whether it was not presented to the student (UA) UNATTEMPTED ON ASSESSMENT. All three categories are classified as incorrect.

You will note that items 21 through 23 are listed as:

* UNATTEMPTED

This is a reminder that these items were not presented. There are two possible causes for * UNATTEMPTED items.

1. The student reached his/her ceiling of three consecutive incorrect responses and the remainder of the SECTION was skipped.
2. The assessment was interrupted (or terminated) before the end of the SECTION (or the ceiling) was reached.

Items that are * UNATTEMPTED are counted as incorrect responses when the percentage of correct responses are calculated. All calculations of percent correct are calculated by dividing the total correct responses by the total number of questions in the SECTION.

2. Student Summary Report

The STUDENT SUMMARY REPORT report is designed to give the teacher an overview of a student's results on the entire assessment (or the portion completed). The STUDENT SUMMARY REPORT gives test results at the SECTION level.

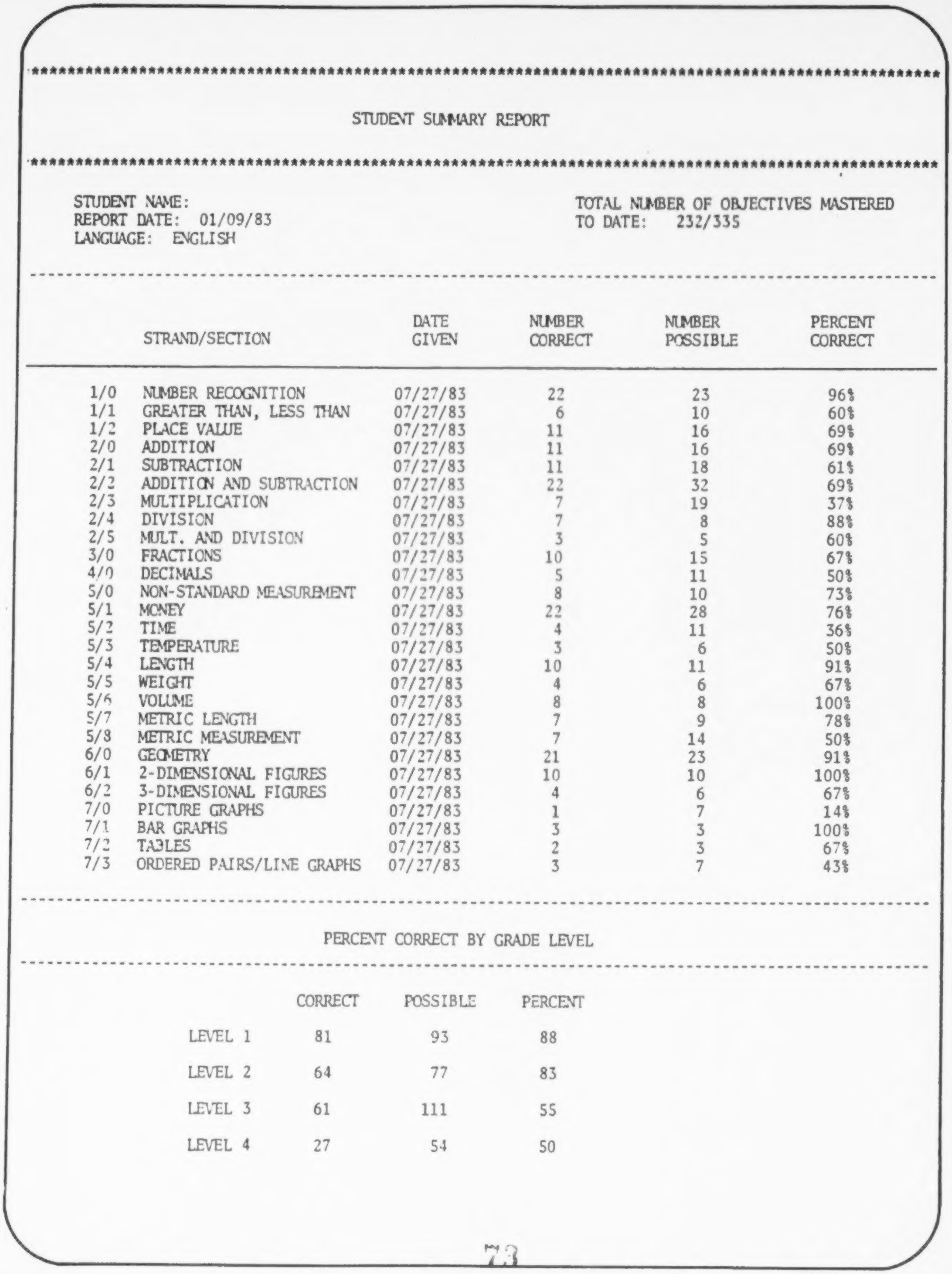
Look at the sample STUDENT SUMMARY REPORT on page **15**. The student information is similar to the one used with the OBJECTIVE TEST RESULTS except that the STUDENT SUMMARY REPORT gives the TOTAL NUMBER OF OBJECTIVES MASTERED to date over all areas tested (in our example the student has been given the entire assessment).

Below the student information are five columns. The STRAND/SECTION column lists all the SECTIONS of the assessment that have been administered to the student. The SECTIONS are arranged in order. The next column gives the date that each of the SECTIONS were administered. In our sample, all SECTIONS were administered on the same day (this will probably not be the case when you use the assessment). The last three columns give the actual results of student performance for each SECTION; they list the NUMBER CORRECT, NUMBER POSSIBLE, and PERCENT CORRECT. For example, on STRAND 1, SECTION 0 (1/0) NUMBER RECOGITION, our student answered 22 of 23 questions correctly. This translates to 96% correct. On STRAND 5, SECTION 2 (5/2) TIME, the student answered 4 of 11 questions correctly for a percentage of 36%.

As you can see, this report helps you identify general areas in which a student is experiencing difficulties. Looking at the PERCENT CORRECT column will quickly give you an idea of the student's strengths and weaknesses.

The Percent Correct by Level Section of the report is another overview of the student's results. This time the results are reported by the number of objectives which the student has mastered at each grade level. This enables you to estimate a student's mastery of skills for grade levels 1-3. (Level 4 does not reflect all the skills in a fourth grade level math program). In our sample report, our student has answered 88% of the first level objectives correctly, but has only answered 55% of the level three objectives.

15



```
*********************************************************************************************

                                  STUDENT SUMMARY REPORT

*********************************************************************************************

     STUDENT NAME:                                   TOTAL NUMBER OF OBJECTIVES MASTERED
     REPORT DATE:  01/09/83                          TO DATE:    232/335
     LANGUAGE:  ENGLISH

---------------------------------------------------------------------------------------------

                                          DATE        NUMBER        NUMBER        PERCENT
           STRAND/SECTION                 GIVEN       CORRECT       POSSIBLE      CORRECT
_____________________________________________________________________________________________

     1/0   NUMBER RECOGNITION            07/27/83       22            23            96%
     1/1   GREATER THAN, LESS THAN       07/27/83        6            10            60%
     1/2   PLACE VALUE                   07/27/83       11            16            69%
     2/0   ADDITION                      07/27/83       11            16            69%
     2/1   SUBTRACTION                   07/27/83       11            18            61%
     2/2   ADDITION AND SUBTRACTION      07/27/83       22            32            69%
     2/3   MULTIPLICATION                07/27/83        7            19            37%
     2/4   DIVISION                      07/27/83        7             8            88%
     2/5   MULT. AND DIVISION            07/27/83        3             5            60%
     3/0   FRACTIONS                     07/27/83       10            15            67%
     4/0   DECIMALS                      07/27/83        5            11            50%
     5/0   NON-STANDARD MEASUREMENT      07/27/83        8            10            73%
     5/1   MONEY                         07/27/83       22            28            76%
     5/2   TIME                          07/27/83        4            11            36%
     5/3   TEMPERATURE                   07/27/83        3             6            50%
     5/4   LENGTH                        07/27/83       10            11            91%
     5/5   WEIGHT                        07/27/83        4             6            67%
     5/6   VOLUME                        07/27/83        8             8           100%
     5/7   METRIC LENGTH                 07/27/83        7             9            78%
     5/8   METRIC MEASUREMENT            07/27/83        7            14            50%
     6/0   GEOMETRY                      07/27/83       21            23            91%
     6/1   2-DIMENSIONAL FIGURES         07/27/83       10            10           100%
     6/2   3-DIMENSIONAL FIGURES         07/27/83        4             6            67%
     7/0   PICTURE GRAPHS                07/27/83        1             7            14%
     7/1   BAR GRAPHS                    07/27/83        3             3           100%
     7/2   TABLES                        07/27/83        2             3            67%
     7/3   ORDERED PAIRS/LINE GRAPHS     07/27/83        3             7            43%

---------------------------------------------------------------------------------------------

                            PERCENT CORRECT BY GRADE LEVEL

---------------------------------------------------------------------------------------------

                             CORRECT     POSSIBLE     PERCENT

                  LEVEL 1      81           93          88

                  LEVEL 2      64           77          83

                  LEVEL 3      61          111          55

                  LEVEL 4      27           54          50
```

3. Error Analysis Report

One of the unique aspects of the IVSET MATH ASSESSMENT PROGRAM is built-in error analysis. This refers to certain patterns of computational errors which some student habitually make because of improper procedure(s) used in computing problems. (Example) STRAND 2 of the assessment will automatically record and analyze student's results in terms of the Error Types which are relevant to the assessment. A listing and description of the Error Types is located on pages .

Let's look at an example ERROR ANALYSIS REPORT (p.). The header gives the same student information seen in all the reports along with a reminder of where to refer to in the manual for an explanation of the error numbers given in the report.

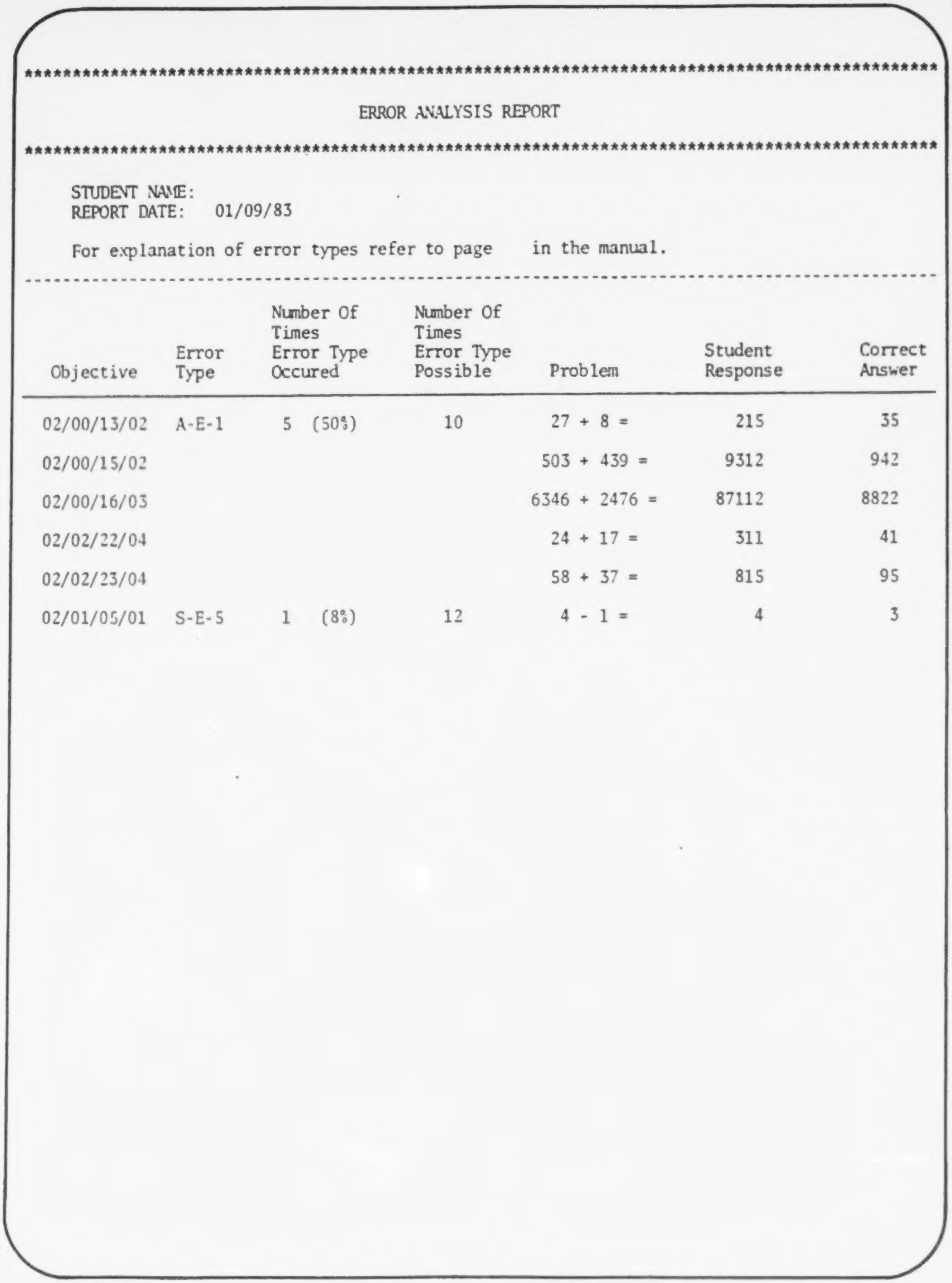
Under the header we see seven columns. The first column is familiar. It gives the code numbers of the objectives which were answered incorrectly (NOTE: Only selected questions from STRAND 2 are included in the error analysis). The next column, ERROR TYPE, gives the code number of the error made. For example, for objective 02/00/13/02 the ERROR TYPE is A-E-1. Referring to the explanation of the ERROR TYPES provided on page you can see that A-E-1 refers to ADDITION ERROR #1.

Addition Error Types

Error	Description	Sample	Occurances:	
			Possible	Actual
A-E-1 Addition Error #1	The student adds and records the ones and then adds and records the tens.	88 +39 1117	4	

When this error occurs frequently, the student is adding and recording the ones and then adding and recording the tens. The description of each type of error includes an explanation owhat causes this particular error and a sample problem which illustrates how the error is made.

The next two columns NUMBER OF TIMES ERROR TYPE OCCURED and NUMBER OF TIMES ERROR TYPE POSSIBLE tell us how many times a student made a particular error and how many chances the student had to make that error. In our sample report ADDITION ERROR #1 was made 5 times (NUMBER ... OCCURED) out of 10 times (NUMBER...POSSIBLE). That is, given ten opportunities to make ERROR TYPE A-E-1 the student made it on five problems. This suggests that this particular error pattern may be made habitually as it was made 5 times out of 10 or 50% of the time. The percentage in parenthesis under NUMBER...OCCURED is the actual percent the error occured.



```
*************************************************************************************************

                                     ERROR ANALYSIS REPORT

*************************************************************************************************

     STUDENT NAME:
     REPORT DATE:   01/09/83

     For explanation of error types refer to page    in the manual.

-------------------------------------------------------------------------------------------------

                          Number Of      Number Of
                          Times          Times
                Error     Error Type     Error Type                    Student        Correct
  Objective     Type      Occured        Possible       Problem        Response       Answer
-------------------------------------------------------------------------------------------------

  02/00/13/02   A-E-1      5  (50%)        10            27 + 8 =          215           35

  02/00/15/02                                           503 + 439 =       9312          942

  02/00/16/03                                          6346 + 2476 =     87112         8822

  02/02/22/04                                            24 + 17 =         311           41

  02/02/23/04                                            58 + 37 =         815           95

  02/01/05/01   S-E-5      1   (8%)        12             4 - 1 =            4            3
```

Look at ERROR TYPE SE5. Notice that this error was made 1 time. (NUMBER...OCCURED) out of 12 (NUMBER ... POSSIBLE). This indicates that this error type (SE5) is not a problem because it was made only one time out of the 12 that it could have been made.

The next three columns (PROBLEM, STUDENT RESPONSE), and CORRECT ANSWER) tell us the actual computation the student was to perform (PROBLEM), the choice selected (STUDENT RESPONSE) and the correct response (CORRECT ANSWER). For example, the second item 02/00/15/02, the PROBLEM was:

503 + 439

The STUDENT RESPONSE was:

9312

and the CORRECT ANSWER was:

942

The ERROR ANALYSIS REPORT allows the teacher to determine what type of computation errors the student made and the frequency with which they occur. The results of the ERROR ANALYSIS REPORT should be used with caution. Any possible problem areas revealed should be further investigated.

ADDITION ERROR TYPES

Error	Description	Sample
A-E-1 Addition Error #1	The student adds and records the ones and then adds and records the tens.	88 +39 1117
A-E-2 Addition Error #2	The student performs the addition from left to right. When the sum of a column is ten or greater, the student records the left figure and places the right figure above the next column to the right.	3 2 618 +782 1112
A-E-3 Addition Error #3	The student adds the units individually as 2 + 6 + 3 = 11.	26 + 3 11
A-E-4 Addition Error #4	The student subtracts instead of adding.	7 + 5 2
A-E-5 Addition Error #5	When adding, the student records but does not carry the ones, tens, hundreds, or thousands.	8714 + 3416 1120
A-E-6 Addition Error #6	The student reverses all or part of the answer.	9 + 3 21

SUBTRACTION ERROR TYPES

Error	Description	Sample
S-E-1 Subtraction Error #1	When subtracting ones, the student thinks the larger of the two numbers as the number of the set, and the smaller as the number to be removed from the set.	$\begin{array}{r}241\\-\ 96\\\hline 255\end{array}$
S-E-2 Subtraction Error #2	The student regroups when unnecessary.	$\begin{array}{r}285\\-\ 63\\\hline 2112\end{array}$
S-E-3 Subtraction Error #3	The student writes "0" for the missing difference whenever the known subtrahend is zero.	$\begin{array}{r}446\\-302\\\hline 104\end{array}$
S-E-4 Subtraction Error #4	In order to subtract, the student puts a 1 in front of the 5 and a 1 in front of the 2, then takes two 1's from the 6.	$\begin{array}{r}\overset{4}{\cancel{6}}\,{}^{1}2\,{}^{1}5\\-348\\\hline 187\end{array}$
S-E-5 Subtraction Error #5	The student adds instead of subtracting.	$\begin{array}{r}63\\-\ 14\\\hline 77\end{array}$
S-E-6 Subtraction Error #6	The student regroups but does not change the value of the tens, hundreds or thousands.	$\begin{array}{r}3{}^{1}8\\-\ 9\\\hline 39\end{array}$
S-E-7 Subtraction Error #7	The student reverses all or part of the answer.	$\begin{array}{r}25\\-\ 9\\\hline 61\end{array}$

DIVISION ERROR TYPES

Error	Description	Sample
D-E-1 Division Error #1	The student thinks of each digit as "ones" and considers one digit of the dividend as the one digit divisor as two numbers "to be divided". The larger of the two re-divided by the smaller and the result is recorded. The remainder is ignored.	$\begin{array}{r} 142 \\ 4\overline{)518} \end{array}$
D-E-2 Division Error #2	The student records the quotient from right to left.	$\begin{array}{r} 68 \\ 6\overline{)516} \\ \underline{480} \\ 36 \\ 36 \end{array}$
D-E-3 Division Error #3	The student subtracts instead of divides.	$15 \div 5 = 10$
D-E-4 Division Error #4	The student adds instead of divides.	$20 \div 4 = 24$
D-E-5 Division Error #5	The student ignores the remainder.	$\begin{array}{r} 78 \\ 6\overline{)531} \\ \underline{48} \\ 51 \\ \underline{48} \\ 3 \end{array}$
D-E-6 Division Error #6	The student reverses all or part of the answer.	$426 \div 6 = 17$

MULTIPLICATION ERROR TYPES

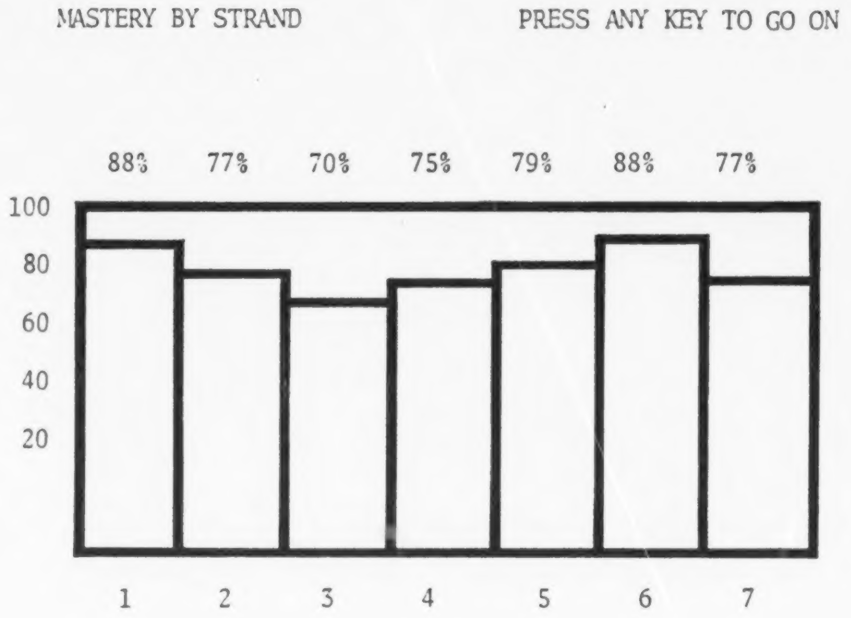
Error	Description	Sample
M-E-1 Multiplication Error #1	The student records a crutch above the tens as a reminder to add the tens to the product. The crutch is used when multiplying by ones and again when multiplying by tens.	$\overset{3}{8}6$ × 45 430 354 3970
M-E-2 Multiplication Error #2	The student does not add the number of tens recorded as a crutch.	$\overset{3}{2}8$ × 4 82
M-E-3 Multiplication Error #3	The student adds the number associated with the crutch before multiplying the tens.	$^{2}29$ × 3 127
M-E-4 Multiplication Error #4	The student approaches each column as separate multiplication, when the multiplicand has more digits than the multiplier the left-most digit of the multiplier continues to be used.	$5\overset{2}{1}7$ × 463 2,081
M-E-5 Multiplication Error #5	The student adds instead of multiplies.	36 × 3 39
M-E-6 Multiplication Error #6	The student multiplies and records the ones and then adds and records the tens.	82 × 5 4010
M-E-7 Multiplication Error #7	The student subtracted instead of multiplies.	9 × 5 4
M-E-8 Multiplication Error #8	The student reverses all or part of the answer.	9 × 3 72

4. Student Progress Graph

The student progress graph gives an overall view of a students mastery of the STRANDS assessed. Progress is depicted by a bar graph showing the percent of mastery for each STRAND.

Percent of mastery is defined as:

$$\text{Percent Mastery} = \frac{\text{Total number correct in STRAND}}{\text{Total number of items in STRAND}}$$



MASTERY BY STRAND PRESS ANY KEY TO GO ON

On the left of the graph are percentage references. On the bottom the STRANDS are numbered from 1 to 7. At the top of the graph, is the exact percent of mastery for each STRAND. The student answered 88% of the STRAND 1 item correctly, 77% of the STRAND 2, etc. It's easy to see that the student is functioning at about the same level in each of the STRANDS. When a student is having difficulty in a particular STRAND(s) it will be apparent on this graph.

B. Interpreting Test Results

The IVSET MATH ASSESSMENT PROGRAM tests 335 math objectives. A single multiple choice item is used to assess each item. Because of the multiple choice test format the user should be aware that chance can influence a student's score. When analyzing a student's responses care should be taken not to put too great an emphasis on whether or not individual items are correct. Instead, the overall pattern of correct and incorrect responses should be examined.

The chance factor can enable a student to progress beyond his/her true ceiling (3 consecutive incorrect responses) because of accurate guessing. This appears as a series of questions which alternate between correct and incorrect responses. Unless the user has reason to believe otherwise, the true ceiling would be at or near where this pattern began. Usually, the student will have several correct responses prior to a pattern of guesses. If instructional decisions areto be based on test results, instruction should be started at the skill level where consecutive correct responses ended.

Items on the MATH ASSESSMENT PROGRAM are administered in order of difficulty. Thus it is reasonable to assume that if a student has correctly answered the great majority of questions in a SECTION and missed a single item near the beginning of the SECTION it could well be that this is because of a careless error or acidental response by the student (unless evidence to the contrary exists), and should not necesessarily be considered as an objective to be mastered. Frequently, a student will intersperse incorrect answers among a series of correct responses. Often there will be a relationship between these incorrect responses (e.g., all involve regrouping).

You should always remember that the system can only report test information. It is your responsibility to analyze this information in light of the students tested and the multiple choice nature of the test given. The IVSET MATH ASSESSMENT VIDEODISC program canrovide you with large amounts of detailed information pertaining to student mastery; however, it is up to you to evaluate and assess this information to make the best use of it.

IV. OPERATING THE VIDEODISC SYSTEM

A STEP BY STEP TUTORIAL

The purpose of this tutorial is to teach you to operate the MATH ASSESSMENT VIDEODISC PROGRAM. In this tutorial you will be guided through each step in administering the assessment and generating reports. We will not address all aspects of the program in this tutorial. For more detailed explanation, we will refer to other parts of the manual. When you see a small box like the one below it will tell you where to look for additional information.

SEE ...

To use this tutorial you will need to have a correctly assembled microcomputer/videodisc system. You will also need the diskettes labelled MATH ASSESSMENT PROGRAM DISKETTE 1, MATH ASSESSMENT PROGRAM DISKETTE 2, MATH ASSESSMENT MANAGEMENT DISKETTE and IVSET FORMATTER and the MATH ASSESSMENT Videodisc.

This tutorial will require about one hour to complete. We suggest that if possible you complete the tutorial in one or two sessions, since the intent is to simulate and familiarize you with the steps you will take to administer the test.

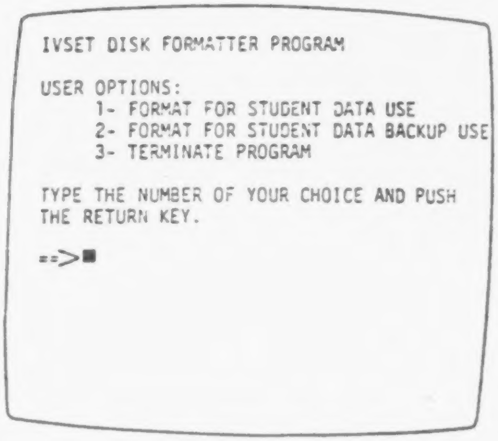
If you do not go through the entire sequence necessary to administer the assessment you may need to refer to the manual frequently during the actual assessment.

Creating A Student Data Diskette

Administering the IVSET MATH ASSESSMENT VIDEODISC program requires the use of two diskettes. One is a MATH ASSESSMENT PROGRAM DISKETTE and the other is a STUDENT DATA DISKETTE. The PROGRAM DISKETTES are provided with the program, but you'll need to make a STUDENT DATA DISKETTE from a blank diskette. On this diskette you can store assessment data for up to 6 students. To make a STUDENT DATA DISKETTE from a blank diskette we need to format (or prepare) it first. Formatting a diskette puts a "map" on the diskette that the computer can follow to ensure the data is recorded properly.

1. Put the diskette labelled IVSET FORMATTER in Disk Drive 1, close the door of the drive and turn on the system. If everything is working properly, the computer will beep, the light on Disk Drive 1 should come on, and the drives should whirr and make a clacking sound.

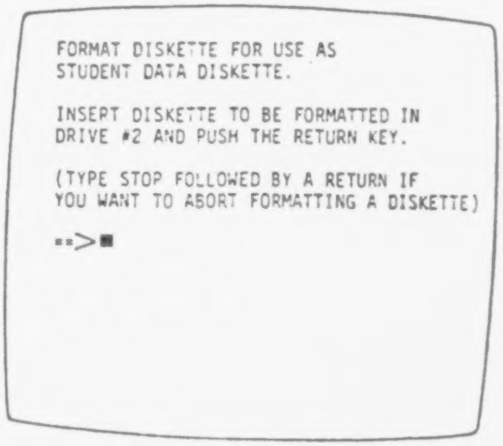
In a few seconds you will see the screen on the right appear on the monitor. Now we are ready to make a STUDENT DATA DISKETTE.



```
IVSET DISK FORMATTER PROGRAM

USER OPTIONS:
     1- FORMAT FOR STUDENT DATA USE
     2- FORMAT FOR STUDENT DATA BACKUP USE
     3- TERMINATE PROGRAM

TYPE THE NUMBER OF YOUR CHOICE AND PUSH
THE RETURN KEY.

==>■
```

See Using floppy diskettes, p. **63**

2. Press 1 and the (RETURN) key. The screen will display:



```
FORMAT DISKETTE FOR USE AS
STUDENT DATA DISKETTE.

INSERT DISKETTE TO BE FORMATTED IN
DRIVE #2 AND PUSH THE RETURN KEY.

(TYPE STOP FOLLOWED BY A RETURN IF
YOU WANT TO ABORT FORMATTING A DISKETTE)

==>■
```

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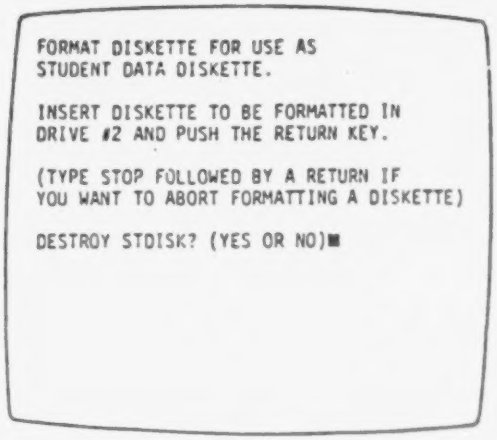
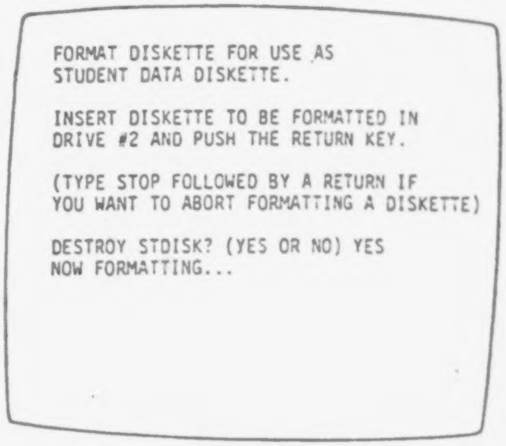
3. Insert the diskette you want to format in Drive 2 and press the (RETURN) key. If there is anything already on your diskette, the screen will show the name of the diskette and ask if you want to destroy it. Remember any information on the diskette in Drive 2 will be destroyed in the formatting process. If you wish to destroy the information, go ahead and type YES and press the (RETURN) key to go on.



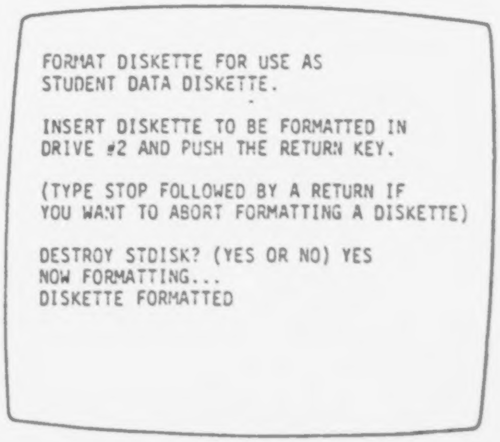
```
FORMAT DISKETTE FOR USE AS
STUDENT DATA DISKETTE.

INSERT DISKETTE TO BE FORMATTED IN
DRIVE #2 AND PUSH THE RETURN KEY.

(TYPE STOP FOLLOWED BY A RETURN IF
YOU WANT TO ABORT FORMATTING A DISKETTE)

DESTROY STDISK? (YES OR NO)■
```

4. The disk drive will begin spinning and the screen will show.



```
FORMAT DISKETTE FOR USE AS
STUDENT DATA DISKETTE.

INSERT DISKETTE TO BE FORMATTED IN
DRIVE #2 AND PUSH THE RETURN KEY.

(TYPE STOP FOLLOWED BY A RETURN IF
YOU WANT TO ABORT FORMATTING A DISKETTE)

DESTROY STDISK? (YES OR NO) YES
NOW FORMATTING...
```

5. The drive will spin for about 20 seconds with the screen showing this display and then return to the display shown in Step 1.

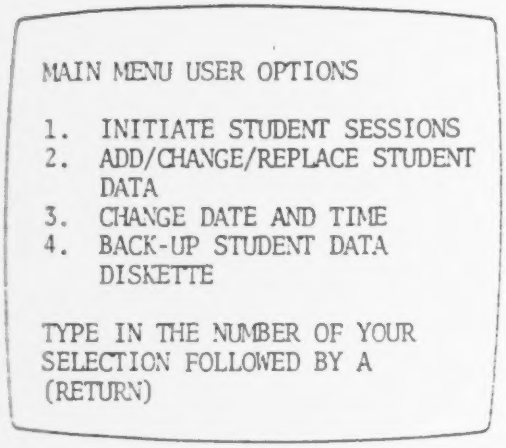


```
FORMAT DISKETTE FOR USE AS
STUDENT DATA DISKETTE.

INSERT DISKETTE TO BE FORMATTED IN
DRIVE #2 AND PUSH THE RETURN KEY.

(TYPE STOP FOLLOWED BY A RETURN IF
YOU WANT TO ABORT FORMATTING A DISKETTE)

DESTROY STDISK? (YES OR NO) YES
NOW FORMATTING...
DISKETTE FORMATTED
```

You won't need to go through this step everytime you give the test, only when you need to create a new STUDENT DATA DISKETTE or a backup diskette. Because each STUDENT DATA DISKETTE you create can hold records for 6 students, you will need to format 1 diskette for every 6 students you plan to test. Label each STUDENT DATA DISKETTE and put the names of the students who will have their data stored on the diskette when you create them to avoid any confusion later.

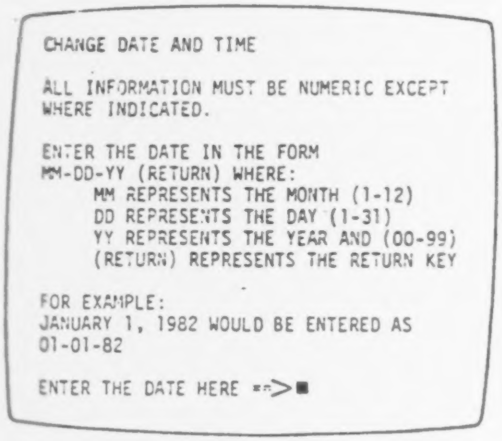
Setting Date and Time

The system will automatically record the date that the test was administered for each student, but first we have to tell it what the present date and time are, just as you must set a new clock to the proper hour and time. If you still have the IVSET FORMATTER DISKETTE in Drive 1 remove it and insert the MATH ASSESSMENT PROGRAM DISKETTE #1. Turn off the system using the power bar, then turn it back on. As before the drives will whirr and clack and in a few seconds you will see the screen on the right appear. This screen is called the MAIN MENU. It is from this menu that you will start every session. Right now we want to set the system to the correct time and date. Type in 3 and press the (RETURN) key.



```
MAIN MENU USER OPTIONS

1.  INITIATE STUDENT SESSIONS
2.  ADD/CHANGE/REPLACE STUDENT
    DATA
3.  CHANGE DATE AND TIME
4.  BACK-UP STUDENT DATA
    DISKETTE

TYPE IN THE NUMBER OF YOUR
SELECTION FOLLOWED BY A
(RETURN)
```

1. When you press the (RETURN) key, the drives will spin briefly and you will see the screen on the right. To set the date for the first time as we're doing, or to change it at a later date, you simply type the date in numerical form and press the (RETURN) key. The screen gives an example of how to type a date correctly. Here are two more:



```
CHANGE DATE AND TIME

ALL INFORMATION MUST BE NUMERIC EXCEPT
WHERE INDICATED.

ENTER THE DATE IN THE FORM
MM-DD-YY (RETURN) WHERE:
     MM REPRESENTS THE MONTH (1-12)
     DD REPRESENTS THE DAY (1-31)
     YY REPRESENTS THE YEAR AND (00-99)
     (RETURN) REPRESENTS THE RETURN KEY

FOR EXAMPLE:
JANUARY 1, 1982 WOULD BE ENTERED AS
01-01-82

ENTER THE DATE HERE ==>■
```

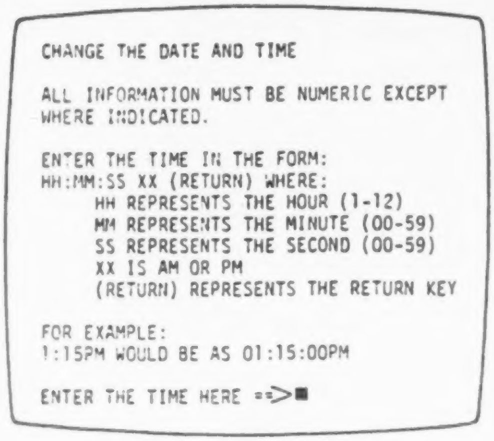
March 14, 1983 = 03-14-83

November 22, 1983 = 11-22-83

Notice that if the month is represented by a single digit you must type in a zero before the digit. Type in the correct date and press the return key.

*NOTE: Anytime you see the ===> you may type STOP and (RETURN)to return to the MAIN MENU without completing the procedure.

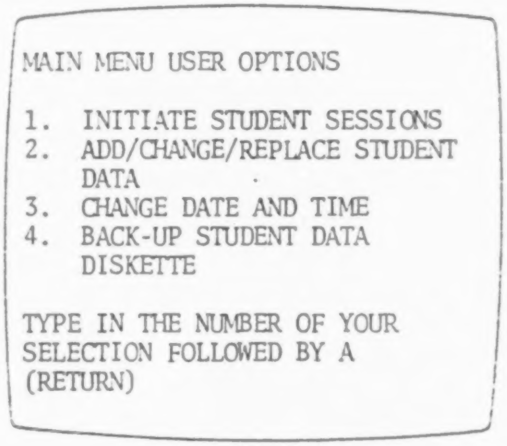
2. The next thing you will see is instructions on setting the correct time. Type in the correct hour, minute, second and a.m. or p.m. and press (RETURN). Remember to include a colon between the hours, minutes and seconds. When you have entered the time correctly you will return to the MAIN MENU. We've got most of the "housekeeping" out of the way and we're ready to get started with the actual testing process now.



```
CHANGE THE DATE AND TIME

ALL INFORMATION MUST BE NUMERIC EXCEPT
WHERE INDICATED.

ENTER THE TIME IN THE FORM:
HH:MM:SS XX (RETURN) WHERE:
     HH REPRESENTS THE HOUR (1-12)
     MM REPRESENTS THE MINUTE (00-59)
     SS REPRESENTS THE SECOND (00-59)
     XX IS AM OR PM
     (RETURN) REPRESENTS THE RETURN KEY

FOR EXAMPLE:
1:15PM WOULD BE AS 01:15:00PM

ENTER THE TIME HERE ==>■
```

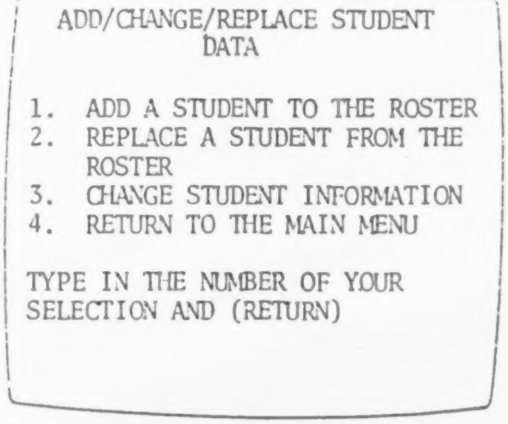
Adding A Student

1. Just as you keep a list of the students in your class, the MATH ASSESSMENT VIDEODISC program must also have a list of the students that will be tested so that it can record their results, etc. To do this we will need to ADD a student to the roster. On the MAIN MENU, select option #2 to ADD A STUDENT. Type in 2 and press the (RETURN) key.



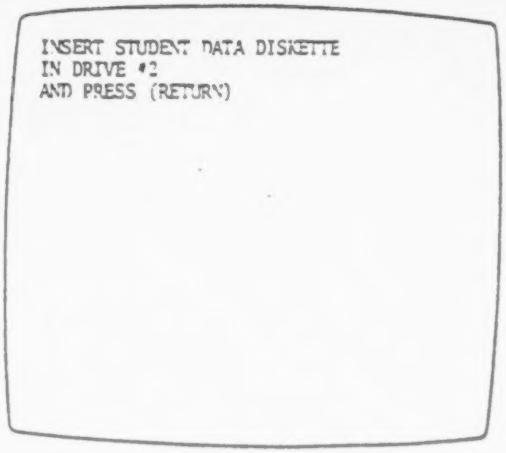
```
MAIN MENU USER OPTIONS

1.  INITIATE STUDENT SESSIONS
2.  ADD/CHANGE/REPLACE STUDENT
    DATA
3.  CHANGE DATE AND TIME
4.  BACK-UP STUDENT DATA
    DISKETTE

TYPE IN THE NUMBER OF YOUR
SELECTION FOLLOWED BY A
(RETURN)
```

2. We call the list the cmputer keeps the ROSTER. Right now the ROSTER is empty since we have not yet added any names. Type in 1 and press the (RETURN) key.



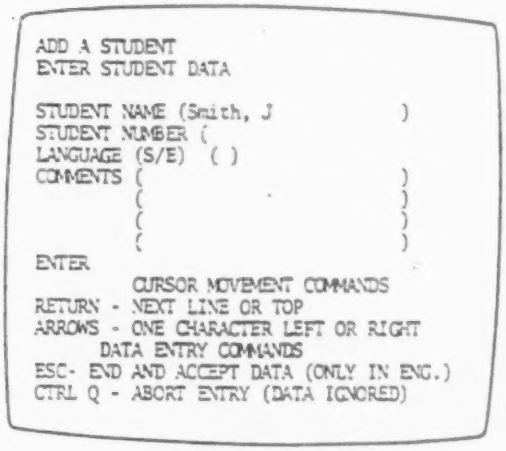
```
  ADD/CHANGE/REPLACE STUDENT
            DATA

1.  ADD A STUDENT TO THE ROSTER
2.  REPLACE A STUDENT FROM THE
    ROSTER
3.  CHANGE STUDENT INFORMATION
4.  RETURN TO THE MAIN MENU

TYPE IN THE NUMBER OF YOUR
SELECTION AND (RETURN)
```

3. Insert a STUDENT DATA DISKETTE in Drive 2 and press (RETURN). If you left the STUDENT DATA DISKETTE we created in Step 1 in the drive simply press the (RETURN) key. Otherwise, insert a STUDENT DATA DISKETTE and press the (RETURN) key.



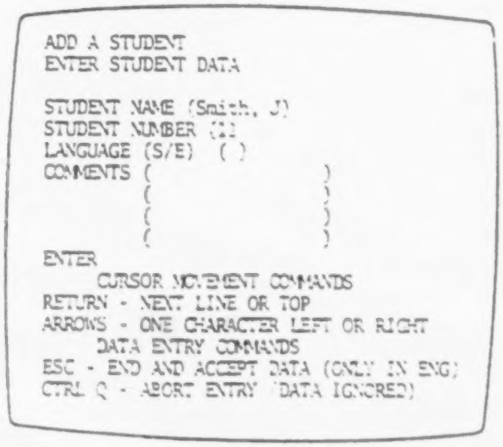
```
INSERT STUDENT DATA DISKETTE
IN DRIVE #2
AND PRESS (RETURN)
```

4. The screen on the right will appear. This is where we tell the system who to add to the ROSTER. Only students on the ROSTER can be tested. The first step in adding a student is to type in the student's name. Since we have a limited amount of space (only 20 characters) we'll use only the last name and first initial for purposes of the tutorial. (You can enter names in the way that is most convenient for you). Type in SMITH, J. and press the (RETURN) key. If you make a mistake in typing, use the left arrow key to back up the cursor (the flashing square) and then type over your mistake.



```
ADD A STUDENT
ENTER STUDENT DATA

STUDENT NAME (Smith, J            )
STUDENT NUMBER (
LANGUAGE (S/E)  ( )
COMMENTS (                        )
         (                        )
         (                        )
         (                        )
ENTER
        CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
      DATA ENTRY COMMANDS
ESC- END AND ACCEPT DATA (ONLY IN ENG.)
CTRL Q - ABORT ENTRY (DATA IGNORED)
```

5. After you pressed the return key the cursor jumped to the next line and is now by STUDENT NUMBER.Pressing the return key will cause the cursor to jump to the next line or to the top if it was on the bottom line. Before you enter the student number try moving the cursor by pressing (RETURN) until it goes by all the lines and is at STUDENT NUMBER once again. The STUDENT NUMBER is included to keep you from accidentally mixing records of stuents with the same name. It's a good idea to keep a separate record of student names and numbers. For our imaginary student's number type in 11 and press (RETURN).

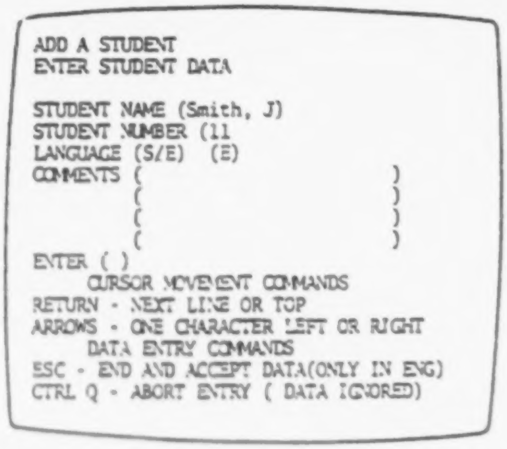


```
ADD A STUDENT
ENTER STUDENT DATA

STUDENT NAME (Smith, J)
STUDENT NUMBER (11
LANGUAGE (S/E)  ( )
COMMENTS (                )
         (                )
         (                )
         (                )
ENTER
     CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
     DATA ENTRY COMMANDS
ESC - END AND ACCEPT DATA (ONLY IN ENG)
CTRL Q - ABORT ENTRY (DATA IGNORED)
```

6. Now the cursor is on the line that reads:

LANGUAGE (S/E) ( )

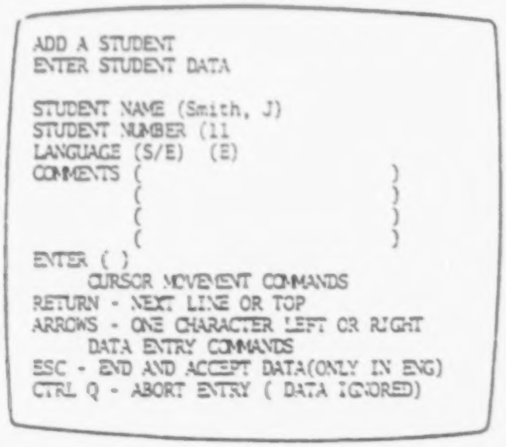
This line tells the computer which language to administer the test in, Spanish or English. We'll assume that SMITH, J. will take the test in English so type in E and press (RETURN).



```
ADD A STUDENT
ENTER STUDENT DATA

STUDENT NAME (Smith, J)
STUDENT NUMBER (11
LANGUAGE (S/E)  (E)
COMMENTS (                        )
         (                        )
         (                        )
         (                        )
ENTER ( )
     CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
     DATA ENTRY COMMANDS
ESC - END AND ACCEPT DATA(ONLY IN ENG)
CTRL Q - ABORT ENTRY ( DATA IGNORED)
```

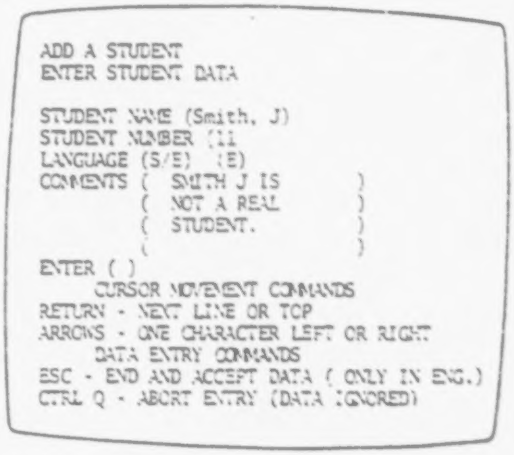
7. You've now entered all the information that has to be entered. Now you may add COMMENTS. This section is a bit like a scratch pad for any reminders, etc. that may relate to a student. Since we don't want our practice student to be confused with a real one, type in:

```
SMITH, J IS   (Press (RETURN))
NOT A REAL    (Press (RETURN))
STUDENT.      (Press (RETURN))
```



```
ADD A STUDENT
ENTER STUDENT DATA

STUDENT NAME (Smith, J)
STUDENT NUMBER (11
LANGUAGE (S/E)  (E)
COMMENTS (                        )
         (                        )
         (                        )
         (                        )
ENTER ( )
     CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
     DATA ENTRY COMMANDS
ESC - END AND ACCEPT DATA(ONLY IN ENG)
CTRL Q - ABORT ENTRY ( DATA IGNORED)
```

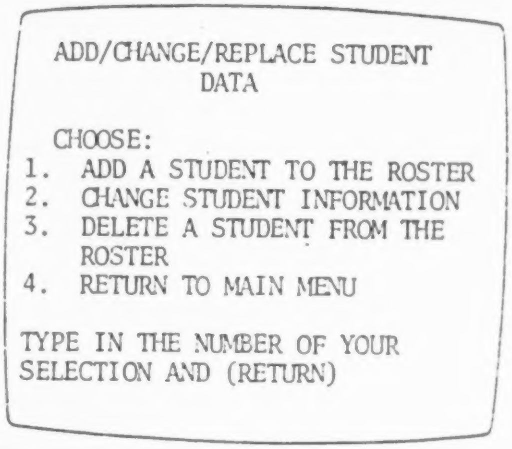
8. Now the cursor should be on the line by ENTER. This is where we tell the system to actually store the information on the STUDENT DATA DISKETTE. Press the ESC key. The disk drive will spin for about 40 seconds and a new screen will appear. If you had gone this far (before you pressed ESC) and decided not to enter the student on the ROSTER you could hold down CRTL and press Q (we'll write it CRTL Q) and the information would be ignored.



```
ADD A STUDENT
ENTER STUDENT DATA

STUDENT NAME (Smith, J)
STUDENT NUMBER (11
LANGUAGE (S/E)  (E)
COMMENTS (  SMITH J IS            )
         (  NOT A REAL            )
         (  STUDENT.              )
         (                        )
ENTER ( )
     CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
     DATA ENTRY COMMANDS
ESC - END AND ACCEPT DATA ( ONLY IN ENG.)
CTRL Q - ABORT ENTRY (DATA IGNORED)
```

See Keyboard Layout, pp **64, 65**

9. If you were really setting up a ROSTER you would select choice 1 and add another student. You would continue this process until you had added all the students you were going to test.

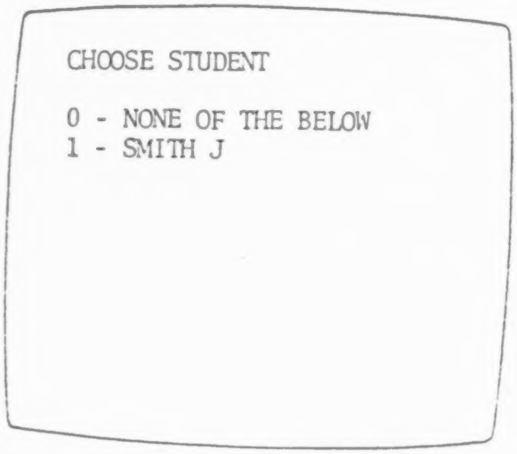


```
ADD/CHANGE/REPLACE STUDENT
          DATA

 CHOOSE:
1.  ADD A STUDENT TO THE ROSTER
2.  CHANGE STUDENT INFORMATION
3.  DELETE A STUDENT FROM THE
    ROSTER
4.  RETURN TO MAIN MENU

TYPE IN THE NUMBER OF YOUR
SELECTION AND (RETURN)
```

Change Student Information

1. To change information on a student type in 2 and press (RETURN).

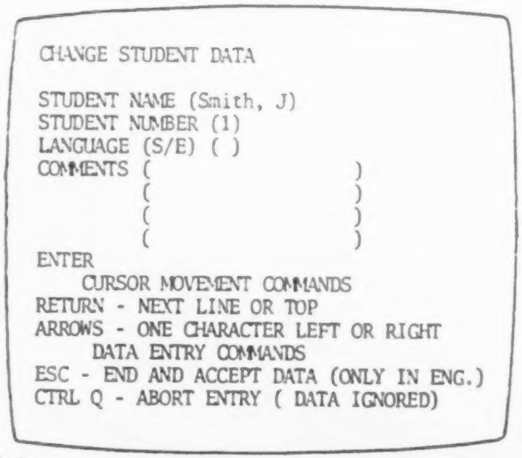
The program will prompt you to put in a STUDENT DATA DISKETTE. Since yours is in Drive 2 already, just press (RETURN). You should see the screen at the right. If you had selected 0 the program would go back to the previous menu where you could change STUDENT DATA DISKETTES (if for example you were changing information on students on other STUDENT DATA DISKETTES). We'll change information on SMITH, J. so type in 1 and press (RETURN).



```
CHOOSE STUDENT

0 - NONE OF THE BELOW
1 - SMITH J
```

NOTE: When ever you see ===> you may type STOP and (RETURN) to return to the MAIN MENU.

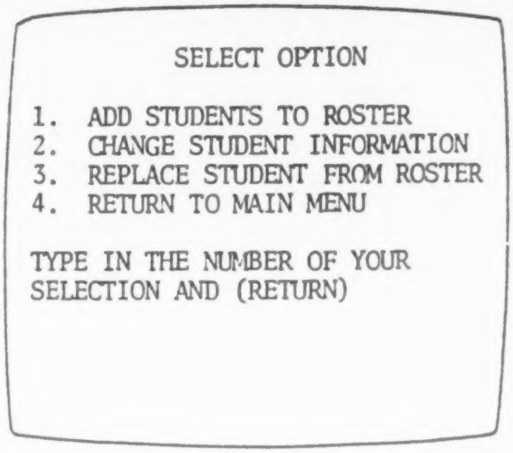
2. Let's give SMITH J a new STUDENT #. Press (RETURN) once to move the cursor to STUDENT #. Change the number to 99 (Type in 99). Now press (RETURN) until the cursor is by ENTER, then press ESC. The drives will spin and the screen prompting you to insert a STUDENT DATA DISKETTE will appear. SMITH J's number is now 99. Since we're done changing information type STOP and (RETURN).



```
CHANGE STUDENT DATA

STUDENT NAME (Smith, J)
STUDENT NUMBER (1)
LANGUAGE (S/E) ( )
COMMENTS (                    )
         (                    )
         (                    )
         (                    )
ENTER
    CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
     DATA ENTRY COMMANDS
ESC - END AND ACCEPT DATA (ONLY IN ENG.)
CTRL Q - ABORT ENTRY ( DATA IGNORED)
```

Replace A Student

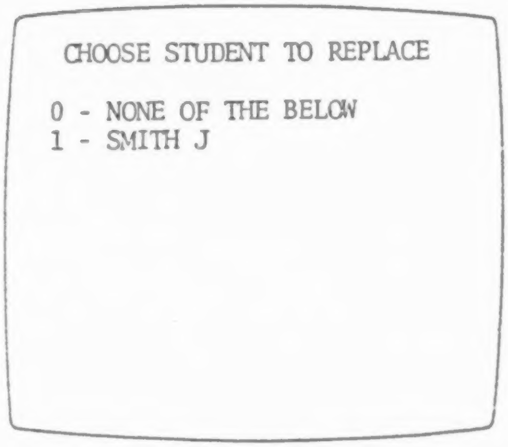
1. At some point you may wish to REPLACE old student information on the roster with new. To do this select 3 from the MAIN MENU.



```
SELECT OPTION

1.  ADD STUDENTS TO ROSTER
2.  CHANGE STUDENT INFORMATION
3.  REPLACE STUDENT FROM ROSTER
4.  RETURN TO MAIN MENU

TYPE IN THE NUMBER OF YOUR
SELECTION AND (RETURN)
```

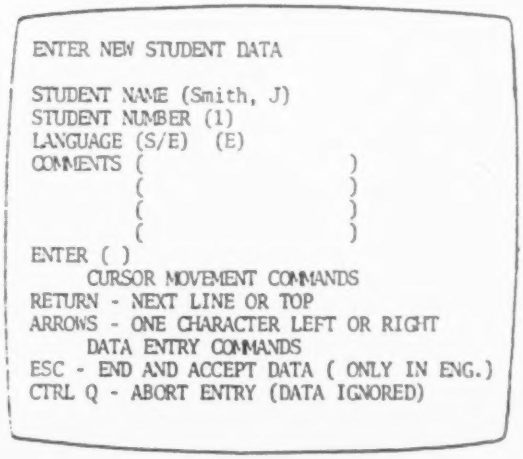
2. The system will then prompt you to insert a STUDENT DATA DISKETTE. When your STUDENT DATA DISKETTE is in Drive 2, press (RETURN).

3. This menu will appear. Typing 0 will allow you to quit without replacing any students. If you wished to replace SMITH, J. you would type 1 and (RETURN).



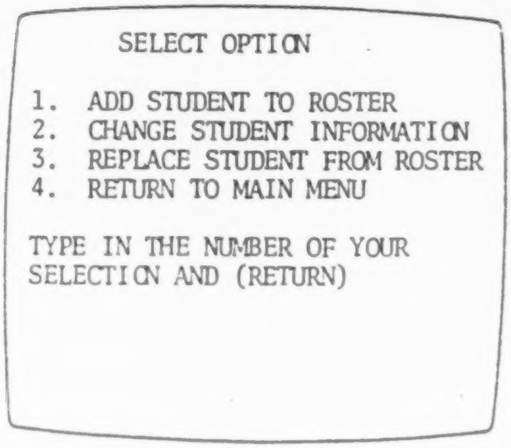
```
CHOOSE STUDENT TO REPLACE

0 - NONE OF THE BELOW
1 - SMITH J
```

4. You will then see this menu. Enter the information for the new student just as you did when you first added students to the roster. Simply type over the old information. After you enter the new information move the cursor by ENTER (use the (RETURN) key) and press ESC.



```
ENTER NEW STUDENT DATA

STUDENT NAME (Smith, J)
STUDENT NUMBER (1)
LANGUAGE (S/E)  (E)
COMMENTS (                    )
         (                    )
         (                    )
         (                    )
ENTER ( )
     CURSOR MOVEMENT COMMANDS
RETURN - NEXT LINE OR TOP
ARROWS - ONE CHARACTER LEFT OR RIGHT
     DATA ENTRY COMMANDS
ESC - END AND ACCEPT DATA ( ONLY IN ENG.)
CTRL Q - ABORT ENTRY (DATA IGNORED)
```

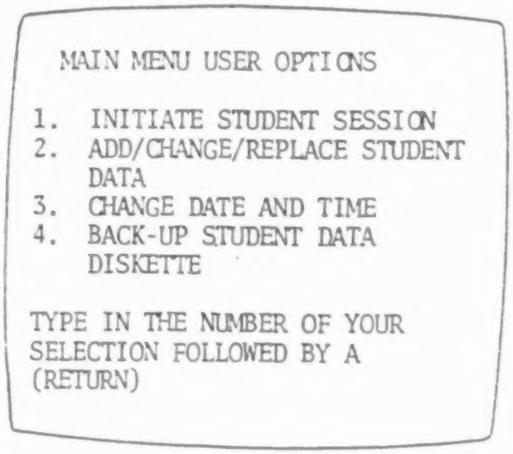
5. After you press ESC the disk drive will spin and "CLEARING OUT OLD FILES" will appear followed by a prompt to insert a STUDENT DATA DISKETTE. Type in STOP and press (RETURN). The menu at the right will appear. Type in 4 and (RETURN) to go back to the MAIN MENU.



```
          SELECT OPTION

1.  ADD STUDENT TO ROSTER
2.  CHANGE STUDENT INFORMATION
3.  REPLACE STUDENT FROM ROSTER
4.  RETURN TO MAIN MENU

TYPE IN THE NUMBER OF YOUR
SELECTION AND (RETURN)
```

Initiate A Student Session

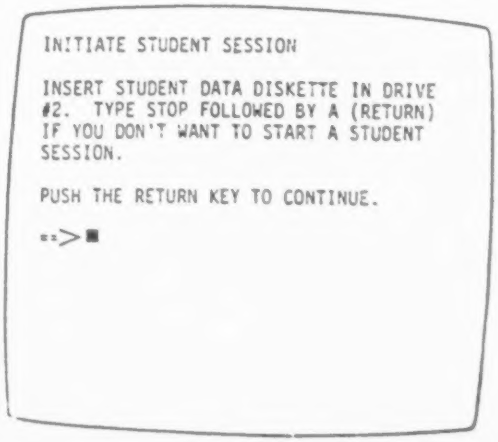
1. From the MAIN MENU we'll select option #1, INITIATE A STUDENT SESSION. This option allows us to give the test. Before you get started, take a few seconds to check and see that the television, touch panel control box and videodisc player are on. Now, type in 1 and press (RETURN).



```
  MAIN MENU USER OPTIONS

1.  INITIATE STUDENT SESSION
2.  ADD/CHANGE/REPLACE STUDENT
    DATA
3.  CHANGE DATE AND TIME
4.  BACK-UP STUDENT DATA
    DISKETTE

TYPE IN THE NUMBER OF YOUR
SELECTION FOLLOWED BY A
(RETURN)
```

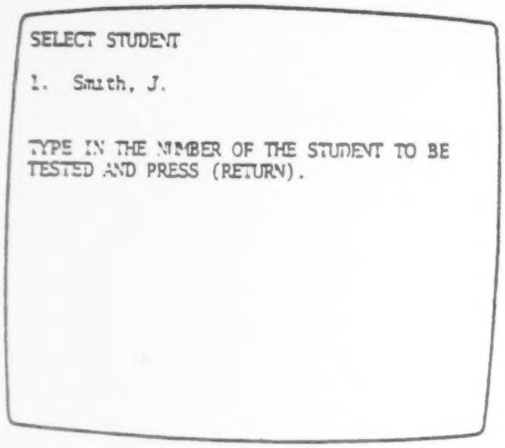
See system diagram, p.**44**

2. Put the STUDENT DATA DISKETTE you created in Drive 2 and press (RETURN).



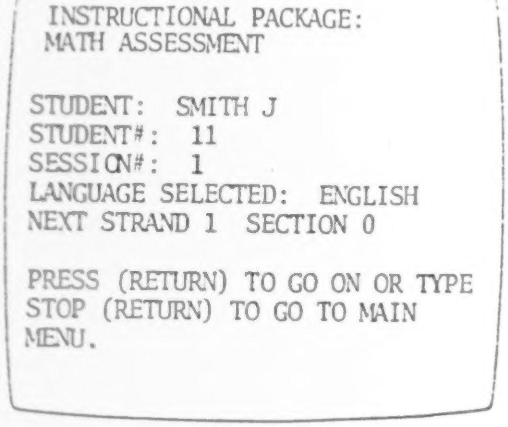
```
INITIATE STUDENT SESSION

INSERT STUDENT DATA DISKETTE IN DRIVE
#2.  TYPE STOP FOLLOWED BY A (RETURN)
IF YOU DON'T WANT TO START A STUDENT
SESSION.

PUSH THE RETURN KEY TO CONTINUE.

==>■
```

3. Now you must tell the program which student you wish to test. Right now we only have one student entered on this STUDENT ROSTER. Every time you add a new student, his/her name will be listed under previous students. The second student will be #2, the third #3 until you have 6 students. Notice that you do not need to type in the student's name only the number. Type in 1 for SMITH, J. and press (RETURN).



```
SELECT STUDENT

1.  Smith, J.


TYPE IN THE NUMBER OF THE STUDENT TO BE
TESTED AND PRESS (RETURN).
```

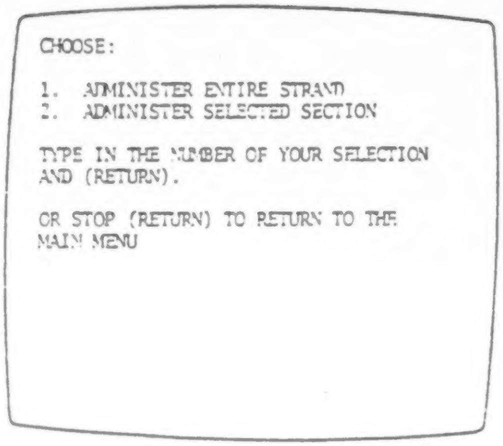
4. Next, you'll see this "reminder" screen gives you information on where the student is in the testing sequence. Since this is the first time our student has worked with the system, SESSION # is 1. The test will be given in ENGLISH, NEXT STRAND is 1, SECTION: 0 tells you where to start the test. Since SMITH, J has not started the test, the system prompts you to start at the beginning of the test. As each student progresses through the test, the system will automatically track their progress for you. The system won't force you to start where the student left off. You could start with any SECTION. The system will always display the STRAND and SECTION that follows the last completed SECTION. For example, if we tested SMITH, J on STRANDS 1 and 2 the next time we test SMITH, J, NEXT would read NEXT STRAND: 3, SECTION: 0.



```
 INSTRUCTIONAL PACKAGE:
 MATH ASSESSMENT

STUDENT:  SMITH J
STUDENT#:  11
SESSION#:  1
LANGUAGE SELECTED:  ENGLISH
NEXT STRAND 1  SECTION 0

PRESS (RETURN) TO GO ON OR TYPE
STOP (RETURN) TO GO TO MAIN
MENU.
```

It's a good idea to check the student information given on this screen to be sure of the STRAND and/or SECTION you want to test. Since everything for SMITH, J is correct press (RETURN) and we'll go on.

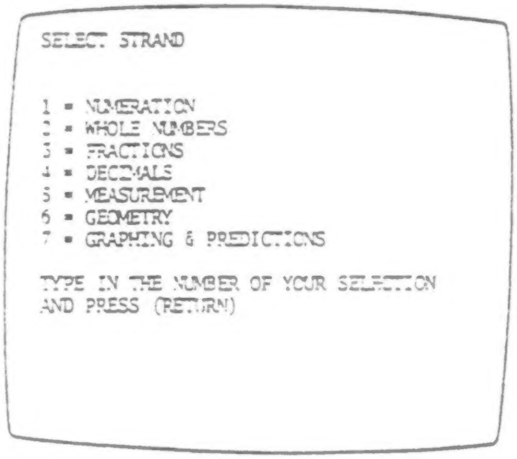
5. The next screen determines how much of the test you'll give. Choosing 1 will cause the system to administer an entire STRAND (which you select). Choosing 2 will cause the system to administer only one SECTION from a STRAND (which you select). Your choice will depend on time availability, the student you're testing, etc. Since this is just a practice session we won't go through an entire STRAND. We'll just go through one SECTION. Type in 2 and press (RETURN).



```
CHOOSE:

1.  ADMINISTER ENTIRE STRAND
2.  ADMINISTER SELECTED SECTION

TYPE IN THE NUMBER OF YOUR SELECTION
AND (RETURN).

OR STOP (RETURN) TO RETURN TO THE
MAIN MENU
```

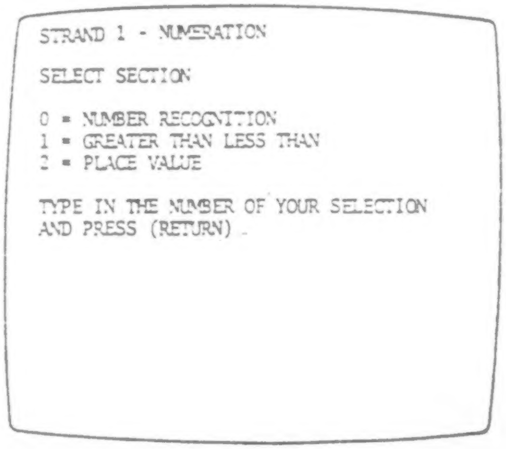
See Using the Assessment with students, p. 5

6. Now we'll choose the STRAND that we will test. Since we're just starting with SMITH, J we'll choose STRAND 1 (remember the "reminder" screen that told us where to start?) Type in 1 and press (RETURN).



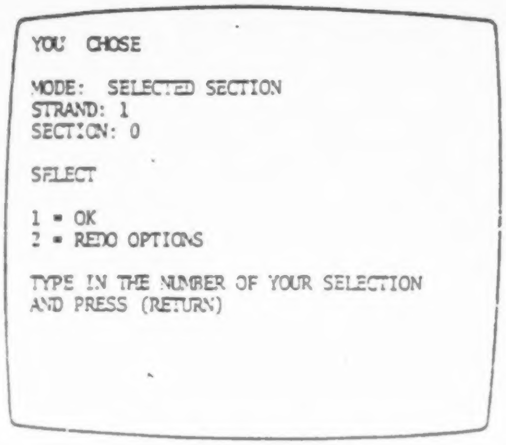
```
SELECT STRAND

1 = NUMERATION
2 = WHOLE NUMBERS
3 = FRACTIONS
4 = DECIMALS
5 = MEASUREMENT
6 = GEOMETRY
7 = GRAPHING & PREDICTIONS

TYPE IN THE NUMBER OF YOUR SELECTION
AND PRESS (RETURN)
```

7. Now the screen prompts us to enter the number of the SECTION we want to test. We'll start with the first SECTION. Type in 0 and press (RETURN).



```
STRAND 1 - NUMERATION

SELECT SECTION

0 = NUMBER RECOGNITION
1 = GREATER THAN LESS THAN
2 = PLACE VALUE

TYPE IN THE NUMBER OF YOUR SELECTION
AND PRESS (RETURN) _
```

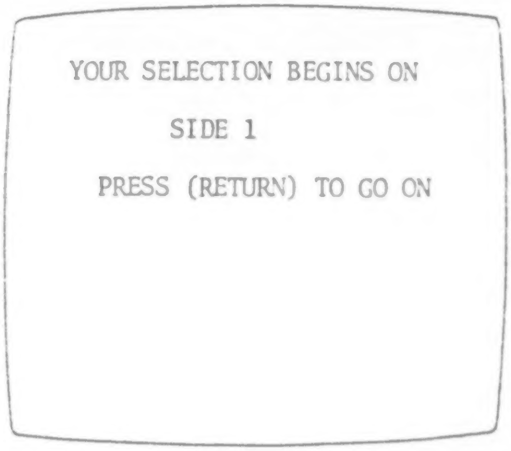
8. This is a "reminder" screen. These "reminder" screens will protect you from accidentally administering a part of the test you didn't want to. If you had made a mistake you could choose REDO OPTIONS. Selecting REDO OPTIONS will return you to the screen where you selected ENTIRE STRAND or SELECTED SECTION. You would then repeat the steps you have just completed. If you have completed the last 4 steps correctly, type 1 and press (RETURN).



```
YOU CHOSE

MODE:  SELECTED SECTION
STRAND: 1
SECTION: 0

SELECT

1 = OK
2 = REDO OPTIONS

TYPE IN THE NUMBER OF YOUR SELECTION
AND PRESS (RETURN)
```

This screen prompts us to check which side of the videodisc is playing. This is important because if the proper side is not facing up, strange things will be presented. Check to see that side 1 is up. If it isn't, turn the disc over. When this is done press (RETURN).

See Changing the Videodisc, pp. **61,62**



```
 YOUR SELECTION BEGINS ON

        SIDE 1

   PRESS (RETURN) TO GO ON
```

After you press (RETURN) you should hear the videodisc player start up and in a few seconds the first question will appear. Go through as many questions as you wish (remember, if you miss three consecutive items the session will end).

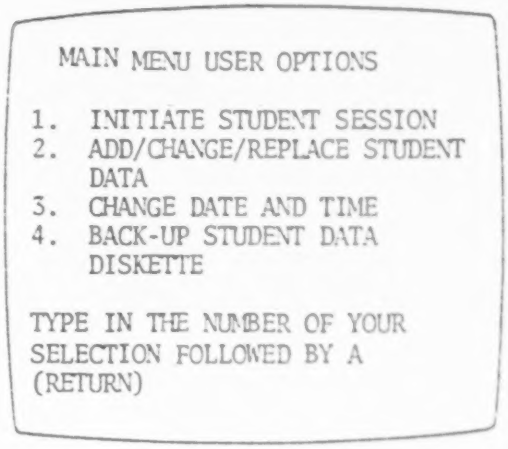
See Test Presentation p. **7**

After the session is complete, Elmo will appear on the screen. Type in E and you will be returned to the MAIN MENU. Repeat this procedure until you become comfortable with it. Work the bugs out in administering the test by yourself, not when a student is waiting.

Backing-Up Student Data Diskettes

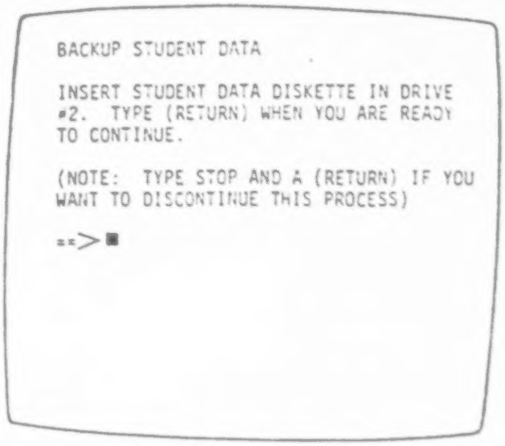
"Backing-up" STUDENT DATA DISKETTES refers to making a duplicate copy (back-up) of a diskette in case something happens to the original. Even with proper care, diskettes may become damaged. If all of a student's data are on one diskette and it should somehow become unusable, valuable information is lost. Back-up diskettes are simply a form of insurance, something like making a photostatic copy of an important document. It is recommended you "back-up" your STUDENT DATA DISKETTES at the end of each day.

1. Before you start this section you will need to have created a back-up STUDENT DATA DISKETTE. This is done in almost the same way as creating a STUDENT DATA DISKETTE. Refer to the section CREATING A STUDENT DATA DISKETTE, p. and follow the instructions for creating a BACK-UP STUDENT DATA DISKETTE. After you have completed the process, remove the BACK-UP DATA DISKETTE and insert the MATH ASSESSMENT PROGRAM DISKETTE #1. Then turn the system off and back on. The disk drives will spin and in a few seconds you will see the MAIN MENU. Type 4 and press (RETURN).



```
MAIN MENU USER OPTIONS

1.  INITIATE STUDENT SESSION
2.  ADD/CHANGE/REPLACE STUDENT
    DATA
3.  CHANGE DATE AND TIME
4.  BACK-UP STUDENT DATA
    DISKETTE

TYPE IN THE NUMBER OF YOUR
SELECTION FOLLOWED BY A
(RETURN)
```

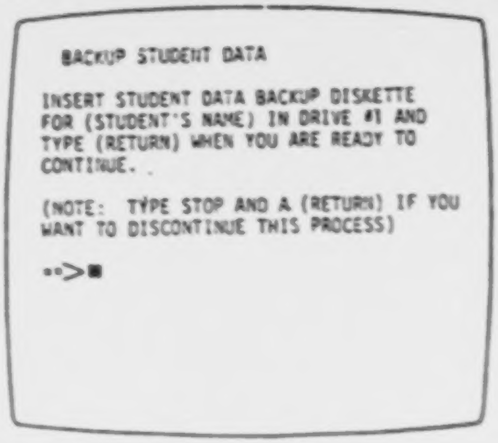
2. Insert the STUDENT DATA DISKETTE you want to back-up in drive #2 and press (RETURN).



```
BACKUP STUDENT DATA

INSERT STUDENT DATA DISKETTE IN DRIVE
#2.  TYPE (RETURN) WHEN YOU ARE READY
TO CONTINUE.

(NOTE:  TYPE STOP AND A (RETURN) IF YOU
WANT TO DISCONTINUE THIS PROCESS)

==>■
```

3. When the drives finish clattering and spinning, you will see this display.....

Remove the MATH ASSESSMENT CONTROL DISKETTE #1 from Drive #1 and insert the BACK-UP STUDENT DATA DISKETTE in Drive 1 and press (RETURN).



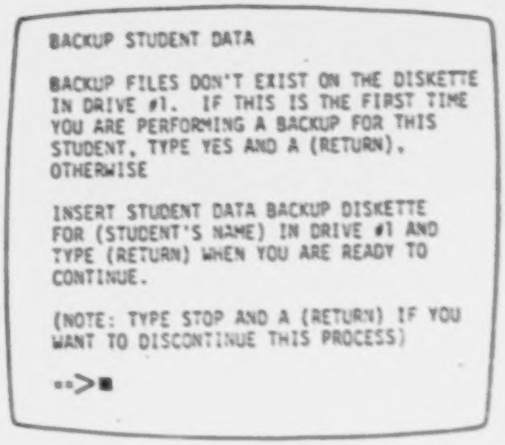
```
BACKUP STUDENT DATA

INSERT STUDENT DATA BACKUP DISKETTE
FOR (STUDENT'S NAME) IN DRIVE #1 AND
TYPE (RETURN) WHEN YOU ARE READY TO
CONTINUE.

(NOTE:  TYPE STOP AND A (RETURN) IF YOU
WANT TO DISCONTINUE THIS PROCESS)

••>■
```

4. Since this is the first time you've used the back-up diskette, the screen will display.....

Type Y for YES and press (RETURN).

The drives will spin for about 1 minute while the original STUDENT DATA DISKETTE is being copied onto the BACK-UP STUDENT DATA DISKETTE. When the back-up process is complete you will be branched back to the display for step #1 to back-up your next STUDENT DATA DISKETTE. To return to the MAIN MENU, type STOP and (RETURN).

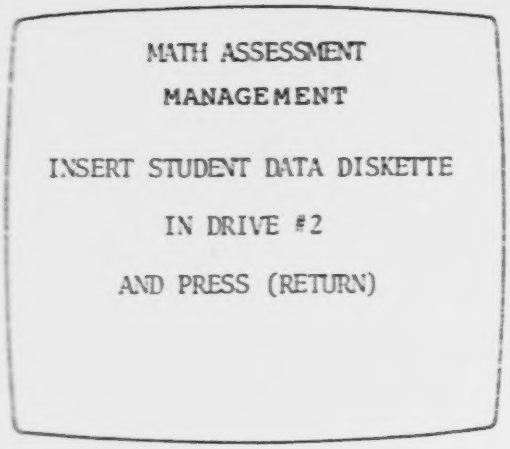
NOTE: Be sure to label your BACK-UP STUDENT DATA DISKETTE immediately and you use it as a back-up to prevent accidentally copying old student data over new student data.



```
BACKUP STUDENT DATA

BACKUP FILES DON'T EXIST ON THE DISKETTE
IN DRIVE #1.  IF THIS IS THE FIRST TIME
YOU ARE PERFORMING A BACKUP FOR THIS
STUDENT, TYPE YES AND A (RETURN),
OTHERWISE

INSERT STUDENT DATA BACKUP DISKETTE
FOR (STUDENT'S NAME) IN DRIVE #1 AND
TYPE (RETURN) WHEN YOU ARE READY TO
CONTINUE.

(NOTE: TYPE STOP AND A (RETURN) IF YOU
WANT TO DISCONTINUE THIS PROCESS)

••>■
```

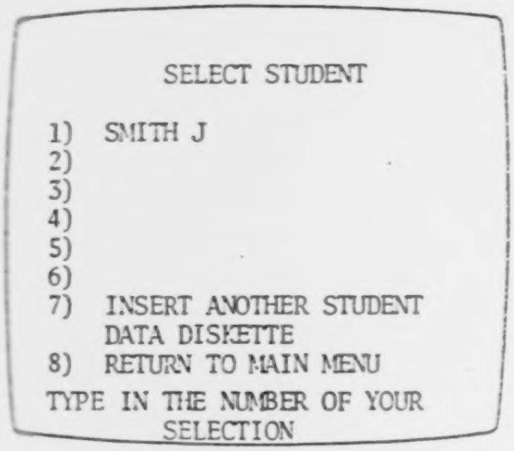
Generating Reports

Insert the **MATH ASSESSMENT MANAGEMENT DISKETTE** in Drive 1 and turn on the system. In a few seconds the screen at the right will appear. Put the STUDENT DATA DISKETTE with the practice session on it in Drive #2 and press (RETURN).



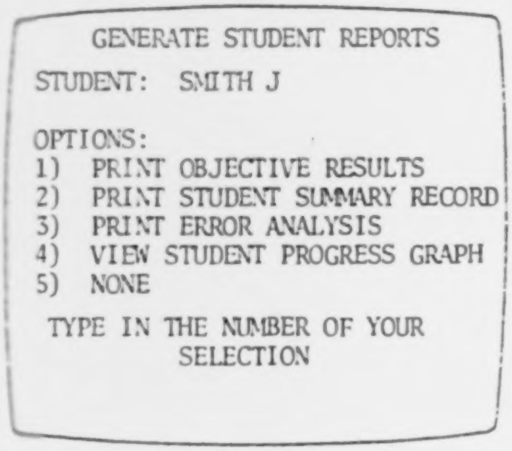
```
MATH ASSESSMENT
MANAGEMENT

INSERT STUDENT DATA DISKETTE

IN DRIVE #2

AND PRESS (RETURN)
```

In a few seconds you will see this screen appear. It contains the name of our practice student (SMITH, J.) following it are numbers 2-6 which are blank. If this were a real diskette it would have students names since you can put 6 students information on one disk. Here you select which student's information you would like reported. You select the student by typing in the number before their name. Type 1 and press (RETURN).



```
SELECT STUDENT

1)  SMITH J
2)
3)
4)
5)
6)
7)  INSERT ANOTHER STUDENT
    DATA DISKETTE
8)  RETURN TO MAIN MENU
TYPE IN THE NUMBER OF YOUR
        SELECTION
```

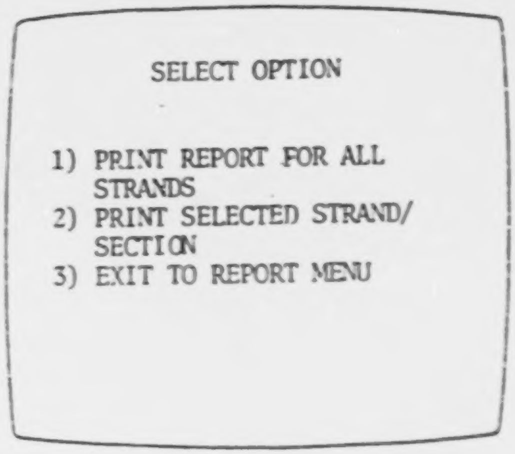
The next screen gives us the option of choosing which of the reports we would like to generate. To generate a report type in the number of the report you wish printed. Before you continue, check to see that the printer is connected and turned on.



```
GENERATE STUDENT REPORTS
STUDENT:  SMITH J

OPTIONS:
1)  PRINT OBJECTIVE RESULTS
2)  PRINT STUDENT SUMMARY RECORD
3)  PRINT ERROR ANALYSIS
4)  VIEW STUDENT PROGRESS GRAPH
5)  NONE
TYPE IN THE NUMBER OF YOUR
        SELECTION
```

Objective Test Results

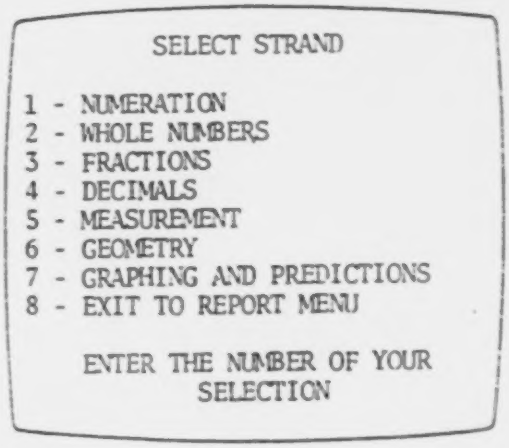
From the GENERATE STUDENT REPORTS typel and (RETURN). The screen at the right will appear. Option 1 will cause every item in every STRAND to be printed. (This takes 15 to 20 minutes and starts immediately).



SELECT OPTION

1) PRINT REPORT FOR ALL STRANDS
2) PRINT SELECTED STRAND/ SECTION
3) EXIT TO REPORT MENU

Option 2 will allow you to select a single STRAND or SECTION to be printed. After you press 2 the menu at the right will appear. Here you select the STRAND you wish printed. If you've made a mistake or simply wish to stop, pressing 8 will allow you to exit. Type in 1 to select a single STRAND.



SELECT STRAND

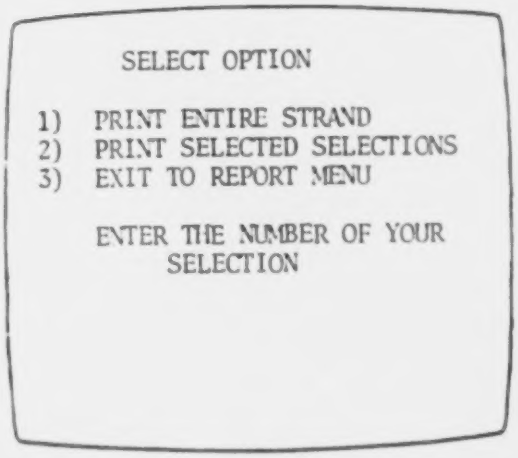
1 - NUMERATION
2 - WHOLE NUMBERS
3 - FRACTIONS
4 - DECIMALS
5 - MEASUREMENT
6 - GEOMETRY
7 - GRAPHING AND PREDICTIONS
8 - EXIT TO REPORT MENU

ENTER THE NUMBER OF YOUR SELECTION

Next this screen will appear. Pressing 1 will print out information for the entire STRAND selected. (You selected STRAND #1 in the previous menu).

Pressing 2 allows you to select a single SECTION to be printed. (We'll choose this option to show the full extent of the REPORT GENERATOR).

Pressing 3 allows you to stop and return to the beginning of the REPORT GENERATOR or back to the MAIN MENU. Type in 2.

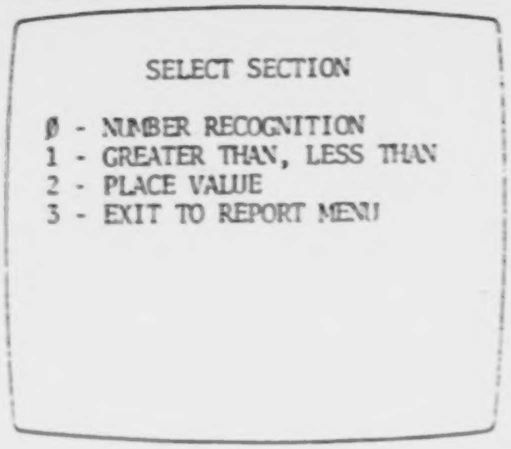


SELECT OPTION

1) PRINT ENTIRE STRAND
2) PRINT SELECTED SELECTIONS
3) EXIT TO REPORT MENU

ENTER THE NUMBER OF YOUR SELECTION

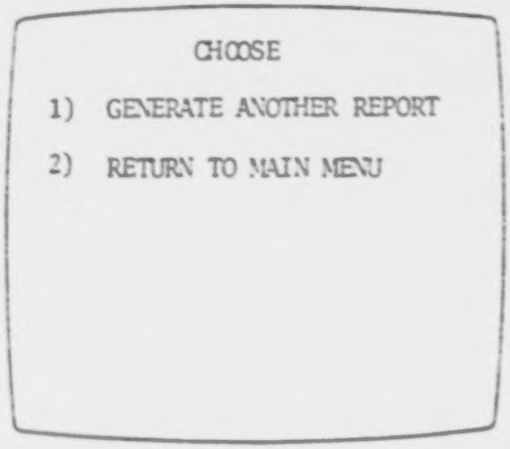
This screen appears. Pressing the number of the desired section will cause it to be printed. Option 3 will allow you to exit. Type in 0. The printer will begin in a minute or so. The results of SMITH J's session will be printed out.



```
SELECT SECTION

0 - NUMBER RECOGNITION
1 - GREATER THAN, LESS THAN
2 - PLACE VALUE
3 - EXIT TO REPORT MENU
```

After the printout is complete, this screen appears. Choosing 1 returns you to the start of the REPORT GENERATOR.

Choosing 2 returns you to the MAIN MENU and will prompt you to insert the PROGRAM DISKETTE.



```
CHOOSE

1)  GENERATE ANOTHER REPORT

2)  RETURN TO MAIN MENU
```

2 - STUDENT SUMMARY REPORT

To obtain a STUDENT SUMMARY Report press 2 from the menu at the right. Printing will start immediately.

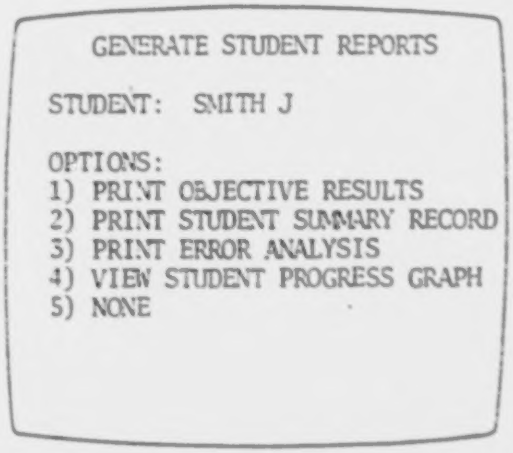
3 - ERROR ANALYSIS

To obtain an ERROR ANALYSIS Report press 3 from the menu at the right. Printing will start immediately.

4 - To see a student's progress graphically depicted press 4. A bar graph will appear showing student mastery for each strand. To continue press any key.

5 - NONE

This option returns you to the menu where you select the student whose information is to be reported.



```
GENERATE STUDENT REPORTS

STUDENT:  SMITH J

OPTIONS:
1) PRINT OBJECTIVE RESULTS
2) PRINT STUDENT SUMMARY RECORD
3) PRINT ERROR ANALYSIS
4) VIEW STUDENT PROGRESS GRAPH
5) NONE
```

APPENDIX A

SETTING UP THE SYSTEM

Setting up the System

Equipment

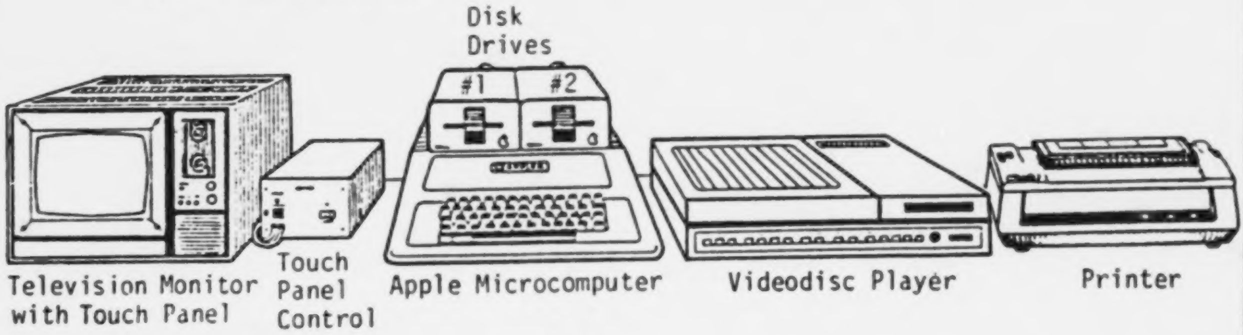
1 Apple II or IIe microcomputer
2 Disk Drives
1 Videodisc Player (DVA 7820, Model 3)
1 Modified Sony Television with front mounted Touch Panel
1 Carroll Touch Panel Control Box
1 Epson Printer
2 Monaural Headphones
1 Six outlet power bar with on/off switch

Circuit Boards

1 Apple Language Board
1 Parallel Interface Board
1 Mountain Hardware Clock Card
1 Allen Communications Videodisc Microcomputer Interface Board w/junction box
1 Apple Disk II Controller Board

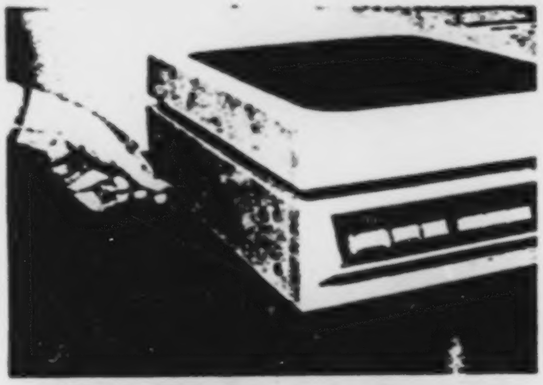
Cables

2 BNC to BNC Coaxial cables (Note: These cables are of different lengths
1 Male RCA mini to Male RCA mini audio cable
1 "26 pin" Amphenol to 12 pin female ribbon cable
1 BNC to male RCA mini coaxial cable
1 "25 pin" male to 10 pin female ribbon cable
1 Multicolored ribbon cable connected to the television monitor
1 Apple power cable
1 Videodisc power cable
1 Touch panel control box power cable
Other power cables are not detachable
Headphone extension cord

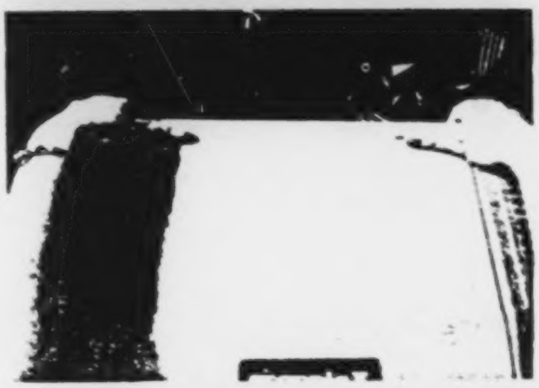

Disk Drives
#1
#2
Television Monitor with Touch Panel
Touch Panel Control
Apple Microcomputer
Videodisc Player
Printer

1. POSITION EACH PIECE OF EQUIPMENT WHERE YOU INTEND TO USE IT. The most common arrangement is shown above.

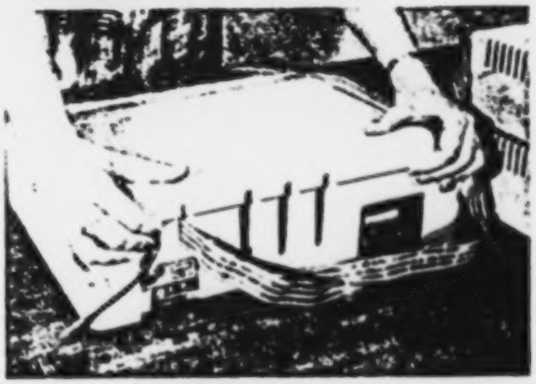
2. UNLOCK THE VIDEODISC TURNTABLE. This is very important! The turntable should always be locked before moving and unlocked before being plugged in. To unlock the player, locate the screw in the small hole on its left side. Using the screw driver supplied with the system, gently turn the screw counter-clockwise until it seems to pop out toward you.



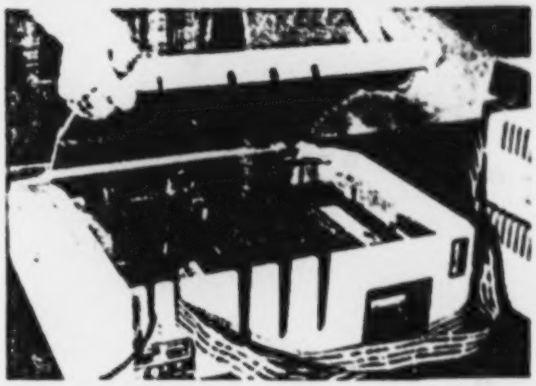
3. If the disk drives are on top of the Apple, remove them. To open the Apple, place your hands at the back of the cover hooking your fingers beneath the lip.



4. Rotate your wrists until the cover panel gives in to your forefingers.

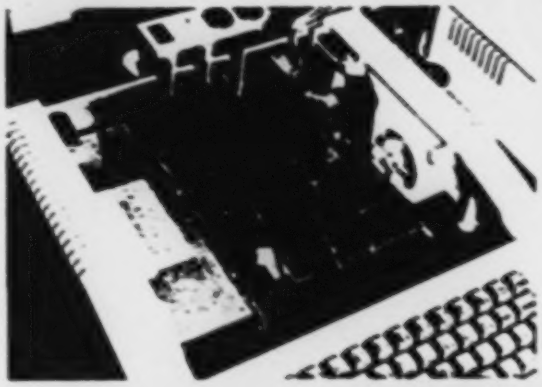


5. When the cover releases, pull it forward towards you. Be careful not to drop the front in the workings of the Apple. Put the cover aside.

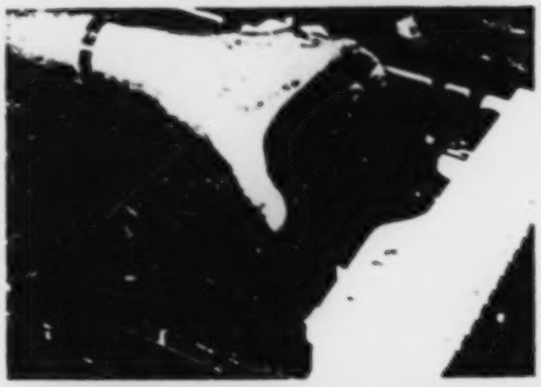


BEST COPY AVAILABLE

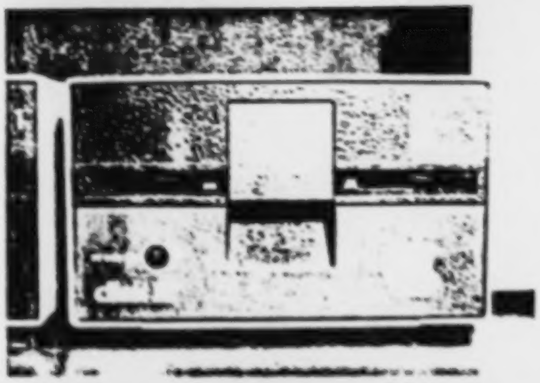
6. The inside of the Apple looks like this.
Each of the green circuit boards sitting in the rear of the Apple serves a particular function in the microcomputer/videodisc system. For a description of each board, its function and location, see page 60. Also, notice the whisper fan located on the right side of the Apple. It has an electrical cord which extends out the rear of the Apple.



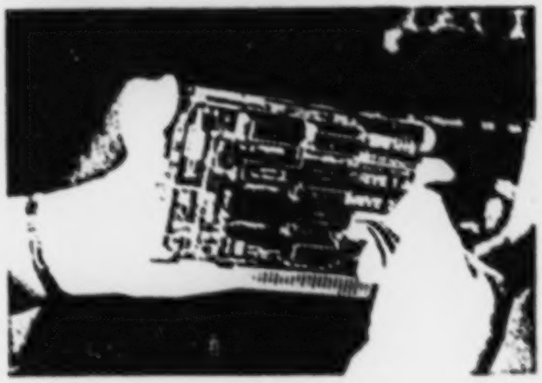
7. The circuit board that controls the disk drives is located in slot #6. Gently wiggle this card out of its slot.



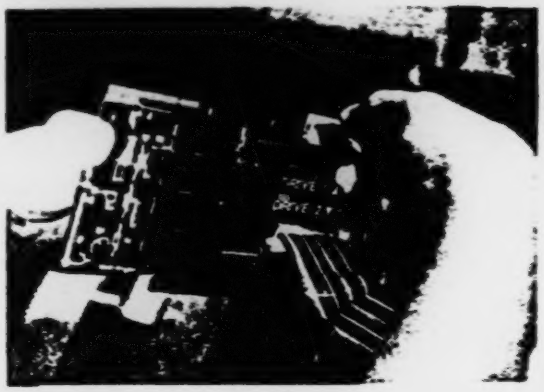
8. Disk Drive #2 is identified by a label on the front of the drive.



9. Connect the flat multicolored ribbon cable from Disk Drive #2 to the pins on the Disk II interface board labelled Drive #2. Be careful to line up the pins with the holes on the connector. MISMATCHING THE PINS AND HOIES WILL RESULT IN SEVERE DAMAGE TO THE DISK DRIVES WHEN THE POWER IS TURNED ON.



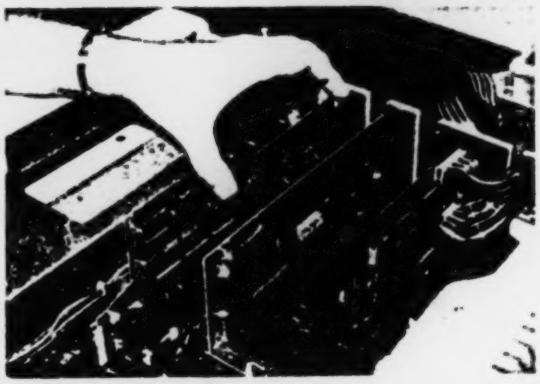
10. Connect Disk Drive #1 to the pins labelled Drive #1. Inspect both cable connections to be sure the holes on the cables are exactly matched to the pins on the Disk II interface board.



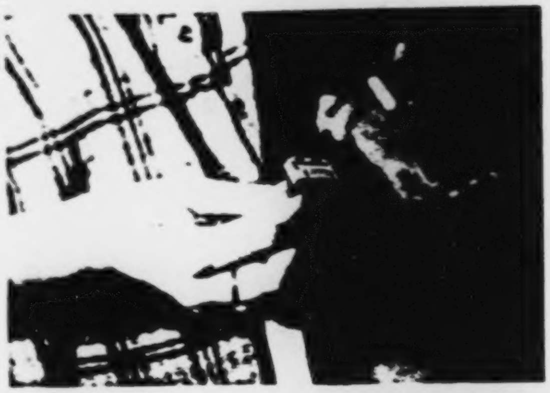
11. Gently wiggle the Disk II interface board back into slot #6. Press firmly on the front and rear of the board to be sure it is seated correctly.

12. Run the attached cables out through the cut outs in the back of the Apple.

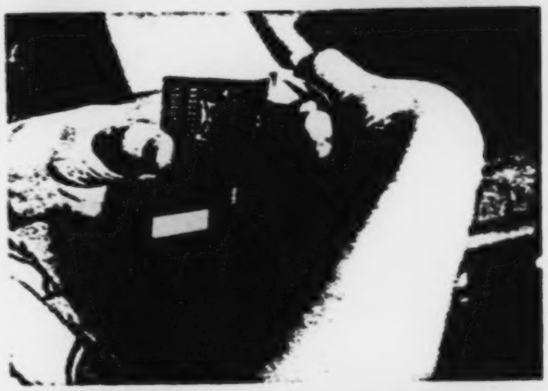
13. Remove the parallel interface board from slot #1 of the Apple.



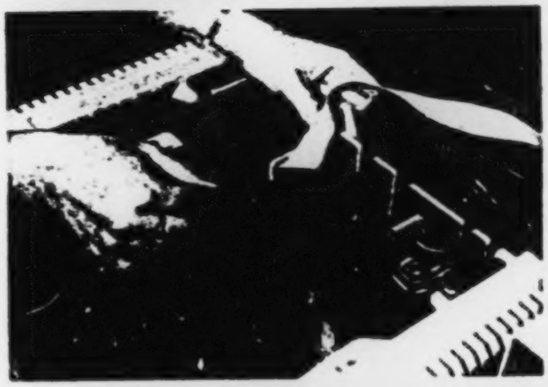
14. Next, locate the flat gray ribbon cable that is connected to the printer.



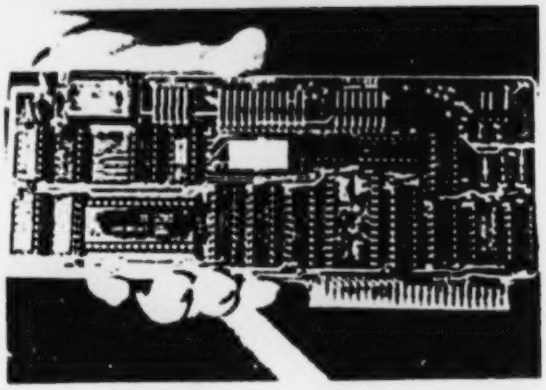
15. Connect the female pin connector to the pins of the parallel interface board. Aqain, be sure the pins are exactly lined up with the connector.



16. Replace the board in slot #1.

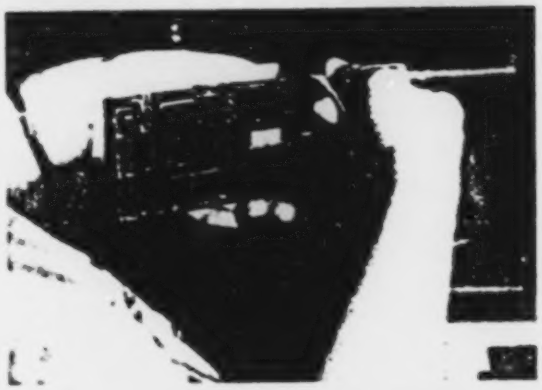


17. Remove the videodisc/microcomputer interface (VMI) board from slot #3. This board has pins for three different connectors.



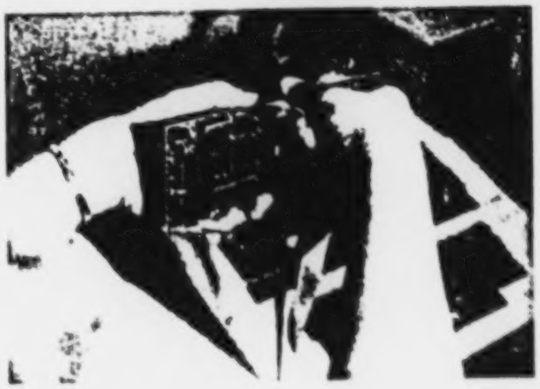
18. This is the VMI junction box. Locate the flat gray cable connected to the box.

19. Connect the gray cable to the set of pins labelled TO VIDEO JUNC. BOX.

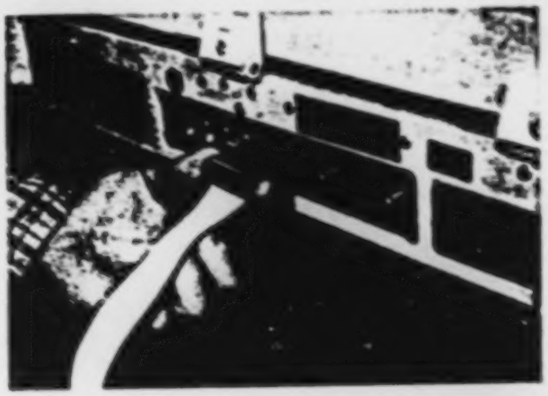


20. Locate the flat multicolored cable with a 12 pin female connector on one end and an Amphenol connector on the other.

21. Connect the 12 pin female connector to the set of pins labelled TO VIDEO-DISC.



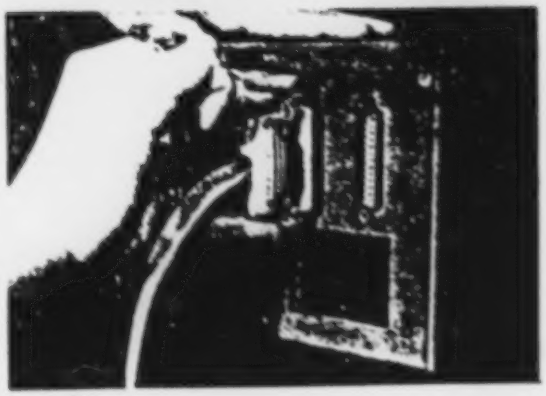
22. Connect the Amphenol end to the EXT CONTROL jack on the videodisc player.



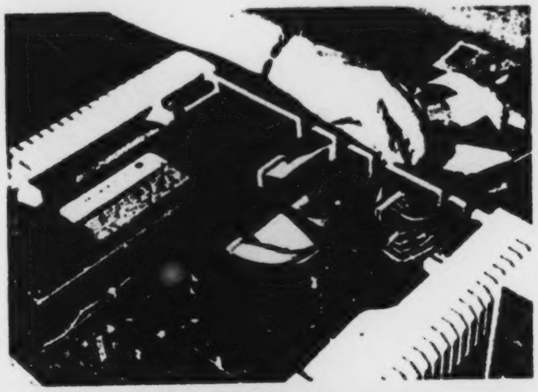
23. Now, locate the flat cable with a 10 pin female connector on one end and a 25 pin male connector on the other.

24. Connect the 10 pin female connector to the set of pins labelled RS232.

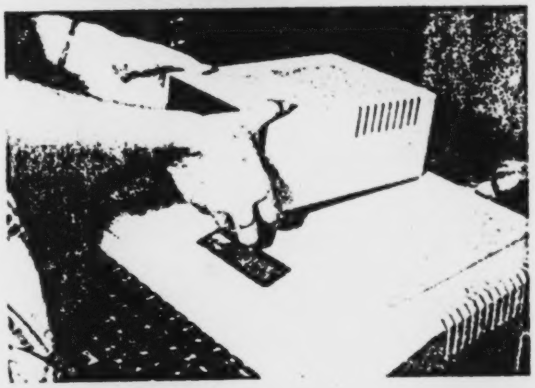
25. Connect the other end of this cable to the jack labelled LINE on the back of the touch panel control box.



26. Slide the VMI board back into slot #3. Run the cables out through the cut outs in the back of the Apple and replace the cover.



27. Place Disk Drive #1 on top of the Apple.

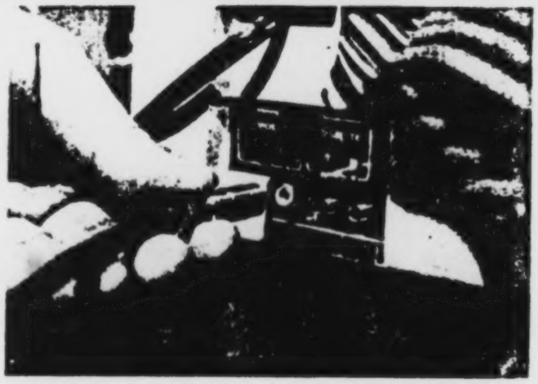


28. Place Disk Drive #2 next to #1.

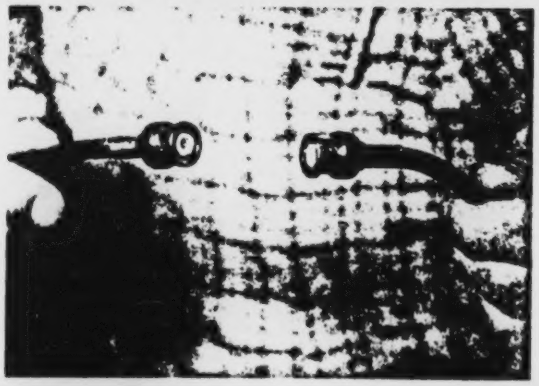
29. Locate the round coaxial cable with a male RCA mini on one end and a BNC connector on the other.

30. Attach the BNC connector to the jack on the VMI junction box labelled COM.

31. Plug the male RCA mini end into the jack labelled VIDEO OUT on the Apple.



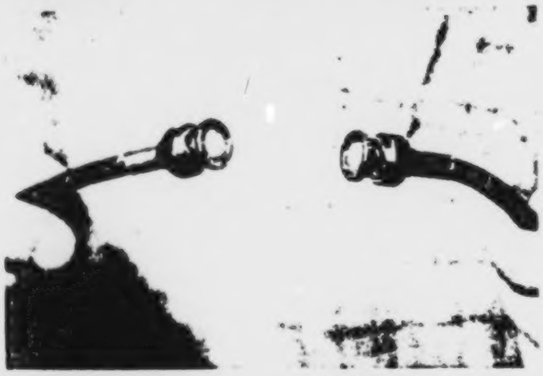
32. Locate a cable with BNC connectors on both ends.



33. Connect one BNC end to the jack on the VMI junction box labelled MON.

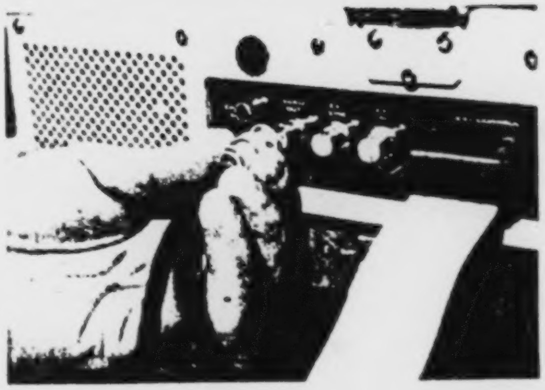
34. Connect the other BNC end to the video "LINE IN" jack on the television. Note: On some televisions the jack may not be a BNC type. In this case, an adaptor will be necessary.

35. Locate the other cable with BNC connectors on both ends.

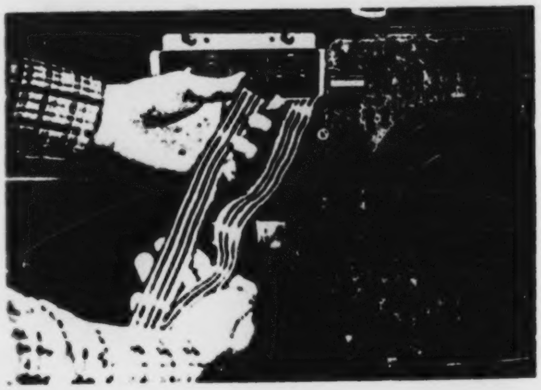


36. Connect one BNC end to the jack labelled VID on the VMI junction box.

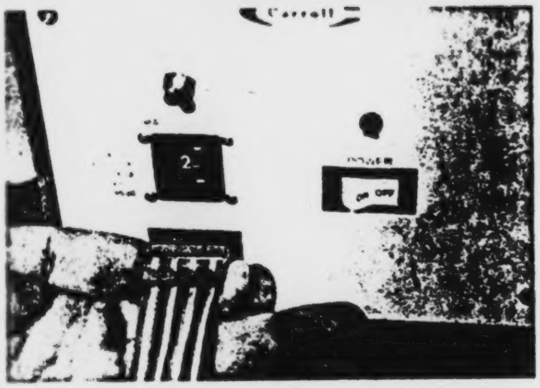
37. Connect the other BNC end to the jack labelled VIDEO OUT on the videodisc player.



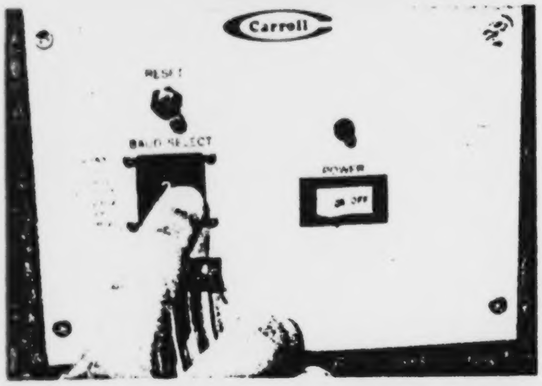
38. Locate the multicolored ribbon cable attached to the back of the television monitor.



39. Connect this cable to the front of the touch panel control box. NOTE: The cable will not connect if it is upside down.

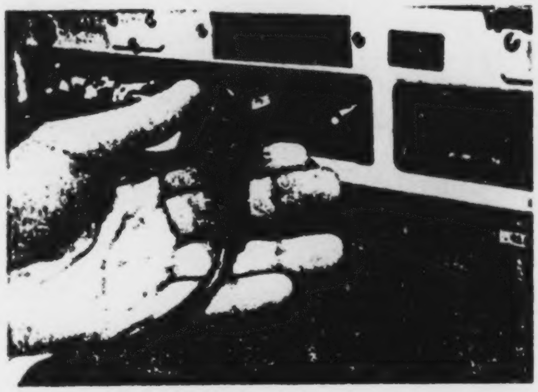

Carroll
2
POWER
ON OFF

40. At this time, check to see that the "baud select" window shows a number 2. If this is not the case, rotate the switch in the window until the number 2 appears.

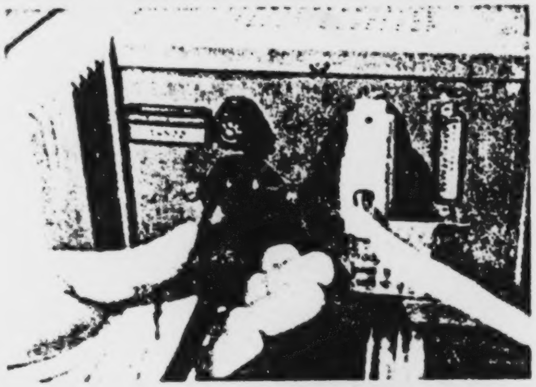

Carroll
RESET
BAUD SELECT
POWER
ON OFF

41. Connect the power cord to the Apple.

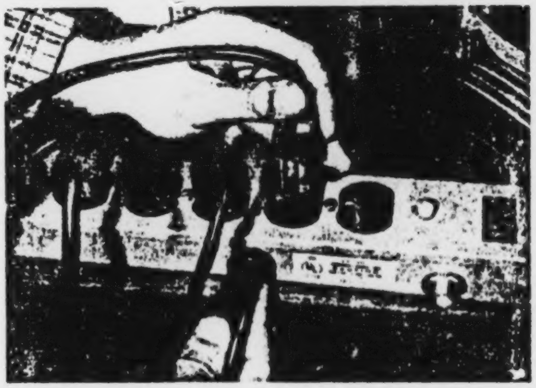
42. Connect the power cord to the videodisc player.



43. Plug the power cord into the back of the touch panel control box.



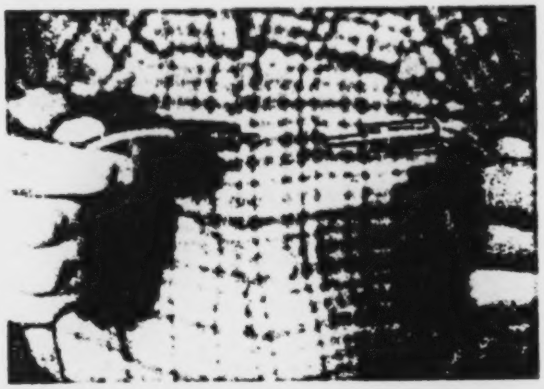
44. Plug the monitor, the touch panel control box, the Apple, the videodisc, the printer and the whisper fan into the outlet bar. Be sure the outlet bar is turned off.



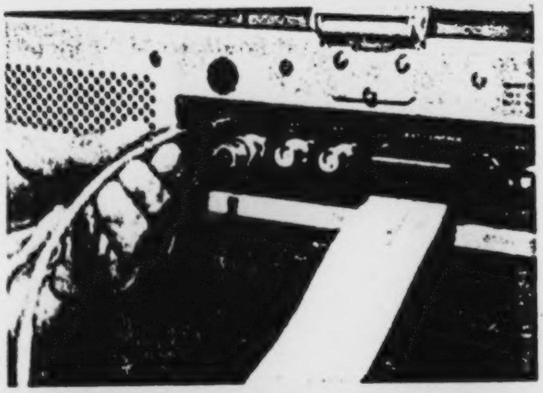
45. Plug the outlet bar into the wall. NOTE: Be sure your outlet is grounded. If you must use a three-prong adapter, loosen the outlet screw and ground the plug.

46. You now need to hook up the audio component of the system. At this time, you have two choices, you may set the system up to (A) play audio through the television speaker or (B) use headphones.

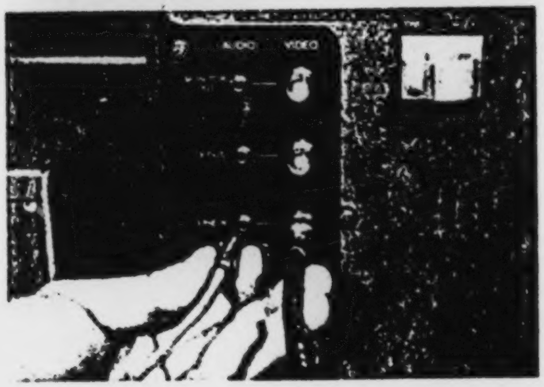
47. A. TO PLAY AUDIO THROUGH THE TELEVISION.
(1) Locate the cable with a male mini plug on one end and a male RCA mini plug on the other end.



48. (2) Plug the male RCA mini plug into the jack labelled CH 1 AUDIO OUT on the videodisc player.



49. (3) Plug the other end into the jack labelled audio LINE IN on the television.



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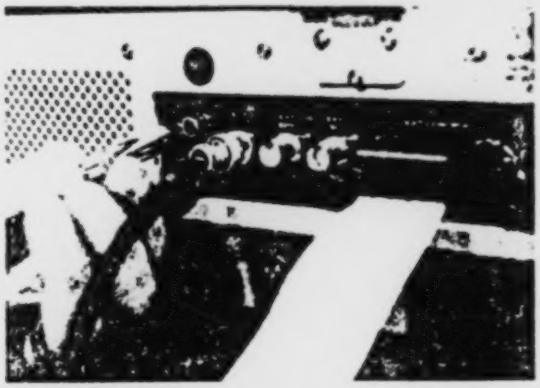
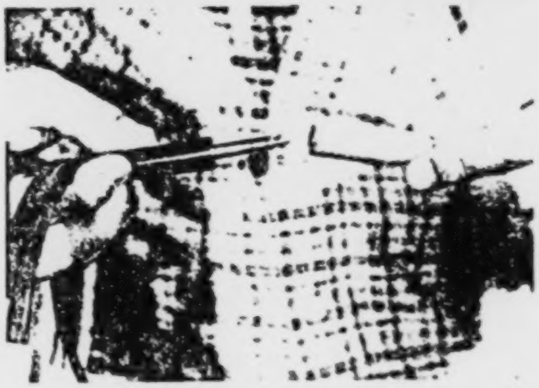
50. B. TO PLAY AUDIO THROUGH THE HEADPHONES.
(1) Locate the Y cable.

51. (2) Plug the male RCA mini plug into the CH 1 AUDIO OUT jack on the videodisc player.

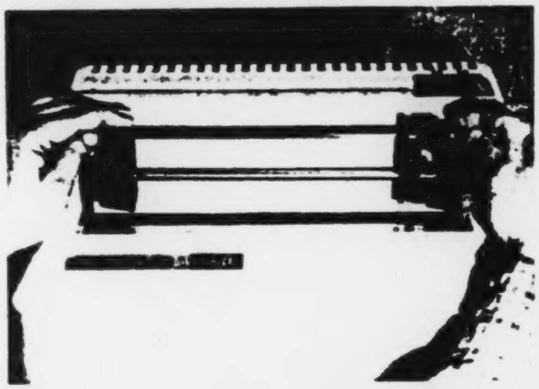


52. (3) Plug the headphones into the female 1/4" phono plugs. An extension cord is available for the second set of headphones. This set is included to allow observation of student interaction with minimal classroom disruption.

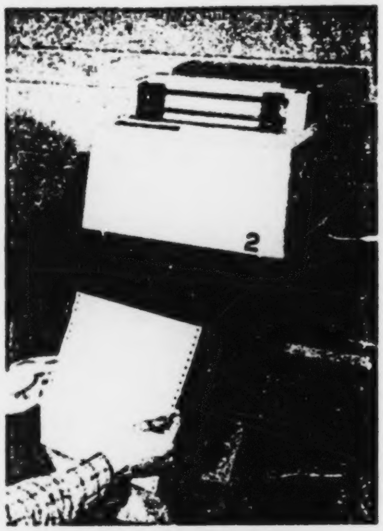


Putting Paper in the Printer

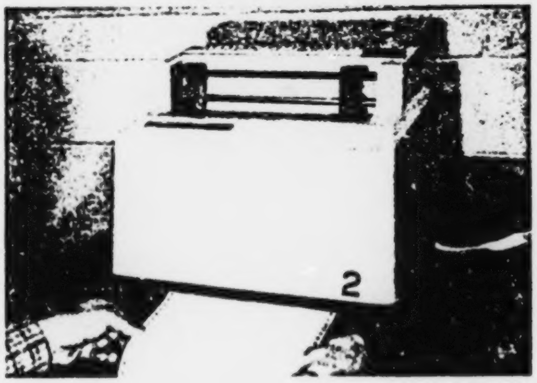
The last task you must complete is loading paper into the printer. To load the printer:



1. Open the clamps which hold the paper on the feeding pins.

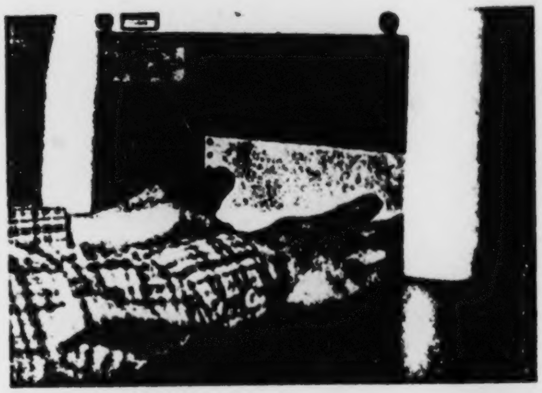


2. Place the paper on the floor in front of the printer.

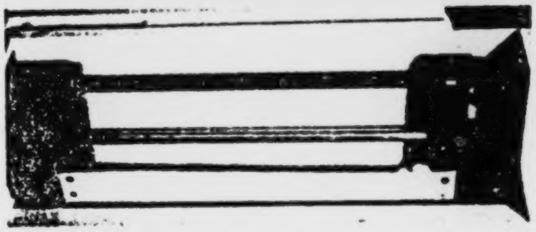


3. Slide the top of the paper underneath the printer.

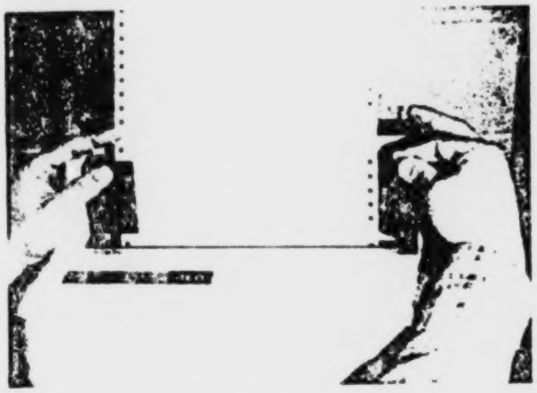
4. Reach around the printer and press the paper against the flat back surface of the printer.



5. Gently slide the paper up until it appears behind the printer ribbon in the front of the printer.



6. Fit the holes in the paper over the pins and release the clamp.Do the same with the other clamp.



Microcomputer Circuit Boards

With the Apple cover off, you will notice the green circuit boards sitting in slots in the rear of the Apple. NEVER TOUCH ANY OF THESE CIRCUIT BOARDS WITH THE APPLE POWER ON. Pulling a circuit board out of the Apple while the power is on will result in damage to the Apple and the boards. From left to right, the slots are labelled #0-#7. The circuit boards are obligated to the slots as follows:

SLOT 0 - Apple Language Board

SLOT 1 - Parallel Interface Board (for use with printer)

SLOT 2 - Mountain Hardware Clock Card

SLOT 3 - VMI Videodisc Interface Board

SLOT 4 - Empty

SLOT 5 - Empty

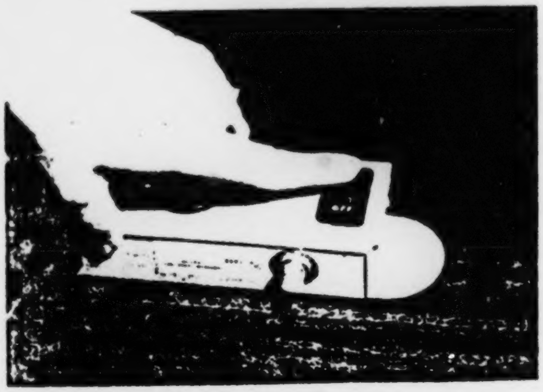
SLOT 6 - Apple Disk II Controller Board

SLOT 7 - Empty

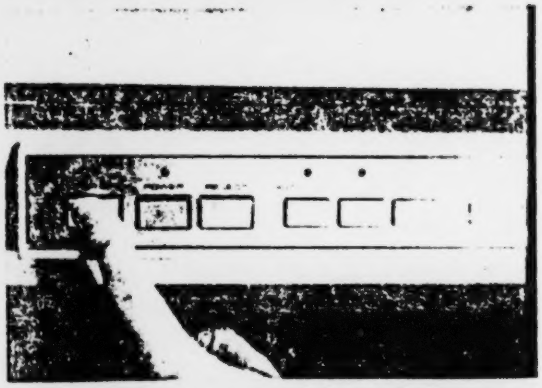
This information is provided for reference only. It is not recommended that boards be removed from or inserted in the Apple after initial set up unless an authorized service person is present.

Changing the Videodisc

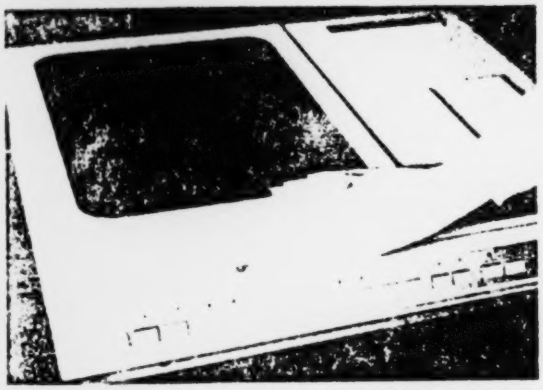
1. Turn the outlet bar power switch to the "ON" position. Be sure the power switch on the player is on. A green light should show.



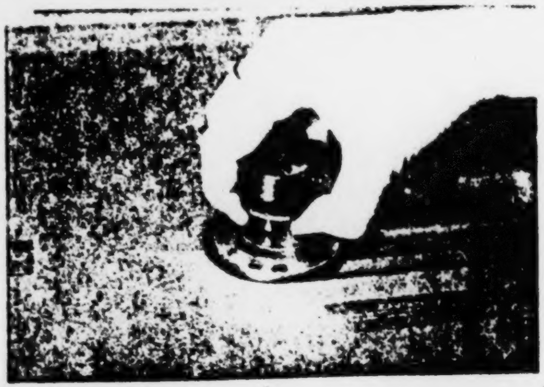
2. Open the videodisc lid by pressing the white button labelled "COVER OPEN". The lid will spring open slightly. If the cover does not spring open, you do not have the power on.



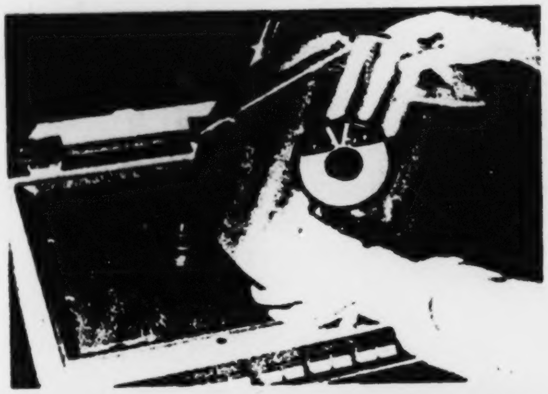
3. Lift the videodisc lid up.



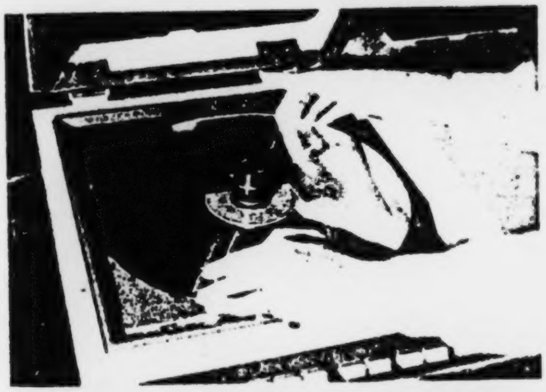
4. Locate the spindle in the center of the videodisc housing. Grasp the lower ring labelled "UNLOCK" and firmly pull straight up.



5. Grasp the videodisc preferably by the edges making sure the side you wish to use is facing you.

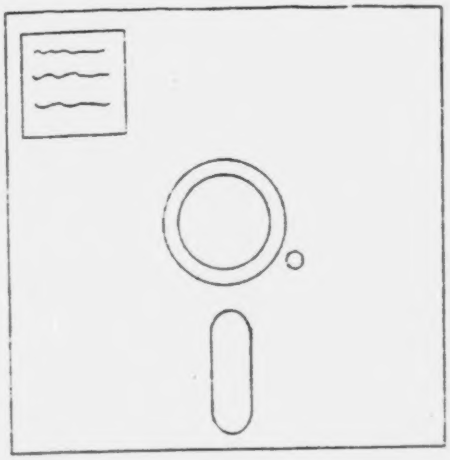


6. Gently place the videodisc on the player spindle.



7. Using your forefingers, press the ears labelled "LOCK" on the top of the spindle. Failure to lock the videodisc down will result in a loud rumbling noise and no picture in the play mode. You may now close the player's lid.

Using Floppy Diskettes



This is a floppy diskette. The diskette is a magnetic medium on which information is stored. You will be using three different types of floppy diskettes. They are:

(1) PROGRAM DISKETTES
(2) STUDENT DATA DISKETTES
(3) MANAGEMENT DISKETTES

There is no physical difference between these diskettes other than their labels. The difference between the two types of diskettes is in the information stored on them and the way in which they are used. The PROGRAM DISKETTE contains the information necessary for the micro-computer/videodisc system to present the instructional program. The STUDENT DATA DISKETTE is used to store information on a student's progress. The MANAGEMENT DISKETTE allows you to obtain reports on student's results.

These diskettes are much more fragile than the videodisc. If you think of PROGRAM diskettes as a major part of the instructional package and STUDENT DATA diskettes as the data storage unit for each student, you'll realize how important it is to safeguard them. The important things to remember in caring for your floppy diskettes are:

1. Handle diskettes gently. Although the diskettes are flexible, bending them can cause damage.

2. Diskette covers are specially treated to clean and lubricate diskettes. Keep diskettes in their covers when not in use. Chalk dust is a major enemy to diskettes in the classroom.

3. Do not let anything touch the diskettes on the brown or grey surface. Handle diskettes by the plactic cover only.

4. Do not place diskettes on greasy or dirty surfaces.

5. Do not write on a diskette, use a felt tip pen only and do not press down hard.

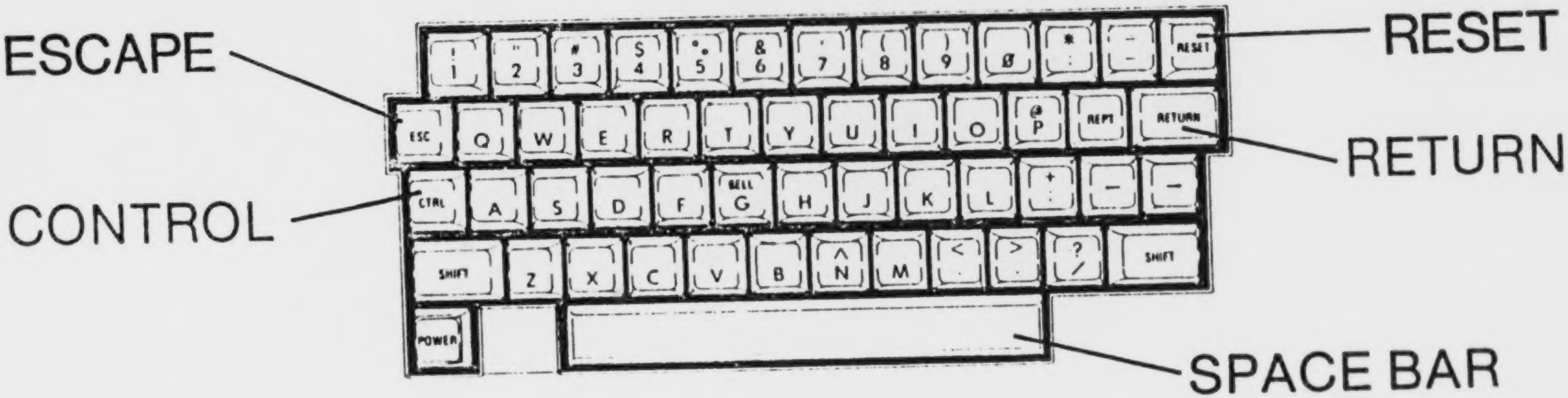
6. Keep diskettes away from magnetic fields.

7. Keep diskettes out of direct sunlight or extremely warm (125 Farenheit) temperatures.

Provision is made in system use to make a "back-up" or extra copy of the STUDENT DATA diskettes. This provides insurance against losing valuable student data. Each PROGRAM diskette comes with a "back-up" diskette as a spare. Put these "back-up" diskettes in a safe place for future use.

IVSET QUICK REFERENCE SHEET

APPLE I I PLUS


ESCAPE
CONTROL
RESET
RETURN
SPACE BAR

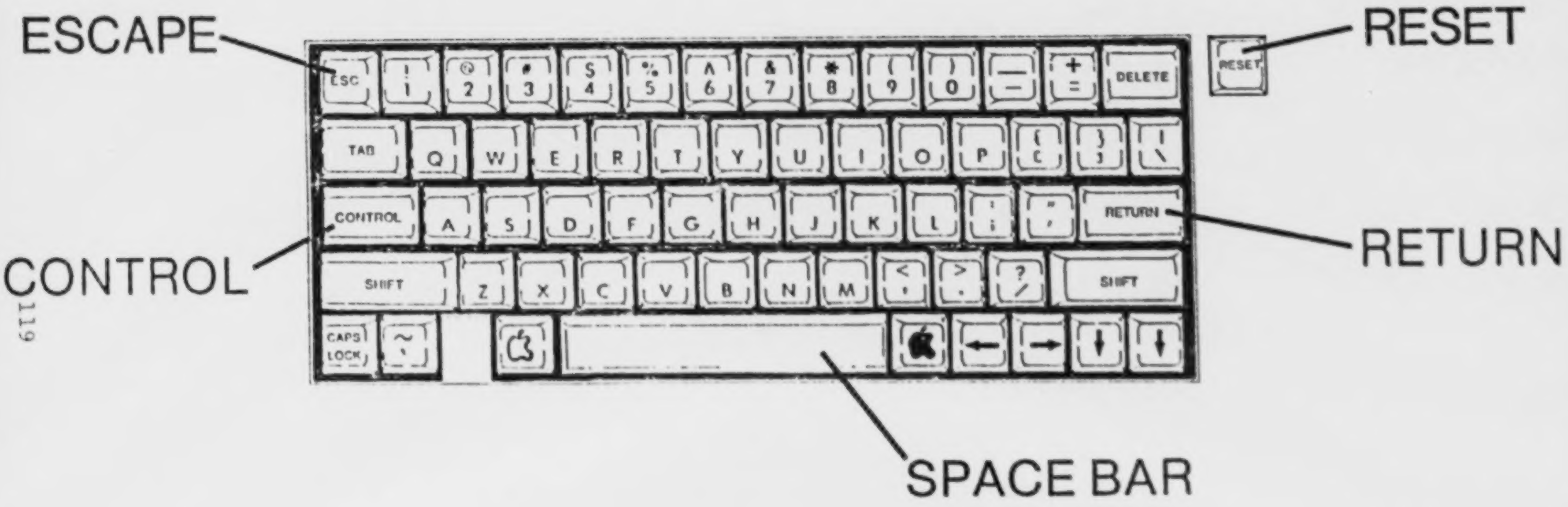
CONTROL RESET - Restarts the computer without turning the power off.

CONTROL A - Switches characters you type on screen from lower case to upper case and visa versa.

E - Ends a session before the specified session length is up.

IVSET QUICK REFERENCE SHEET

APPLE I I-E


ESCAPE
RESET
CONTROL
RETURN
SPACE BAR

CONTROL RESET - Restarts the computer without turning the power off.

E- Ends a session before the specified session length is up.

APPENDIX B

TROUBLE SHOOTING THE SYSTEM

System Troubleshooting

NOTHING HAPPENS	Check all power cords for connection to the machine as well as the outlet bar. Check to see that outlet bar is plugged into wall. Be sure outlet bar power light is on. Check all power switches. Check individual connections.
NO PICTURE	Check to see that the LINE button on the front of the monitor is pushed in. Check the VIDEO LINE IN on the back of the monitor to be sure it is connected (see page 53). Follow the cable from VIDEO LINE IN on the monitor to be sure it's connected to the MON connector on the VMI box (see page 52-53). Follow the cable from the VID connector on the VMI box to the VIDEO OUT on the videodisc (see page 53). Be sure the Amphenol Connector on the back of the videodisc player is connected to the pins labelled TO VIDEODISC on the VMI board (see page 50). Check to see the videodisc material you wish to use is facing up inside the player (see page 62). NOTE: If you wish to use a commercially available videodisc on the player which was produced for the consumer player, it must be put in the player with the material you wish to play on bottom.

NO AUDIO	If you are using audio through the television : Be sure volume on television set is turned up adequately. Check to see that the male mini plug is connected to the back of the monitor in AUDIO LINE IN (see page 56). Check to see that the other end of this cable, the RCA male mini plugs are connected to the back of the videodisc player on CH 1, 2, AUDIO OUT. This cable can be reversed if you try hard enough, but will not work (see page 57). If you are using audio through the headphones: Be sure Y cable is connected to CH 1 audio out on the videodisc player. Check connections to the headphones.
LOUD RUMBLING NOISE WHEN THE VIDEODISC BEGINS TO PLAY	The videodisc is not locked down on the spindle (see page 62).
THE VIDEODISC WILL NOT SPIN	Check power and power cords first. Then be sure the screw holding the videodisc "turntable" has been released (see page 61).
DISK DRIVE(S) WILL NOT STOP SPINNING	1) Push RESET while holding down the CTRL button. 2) Be sure you have diskettes in the drive. 3) Be sure the diskette is one that has been already formatted. 4) If drive will still not stop spinning, replace the diskette.

DISK DRIVE(S) WILL NOT SPIN	1) Be sure Apple is plugged in and the power is on. 2) Turn off Apple power and check to see that the interface card is sitting squarely in slot 6 (see page **47**). 3) Check to see that the disk drives are properly attached to the disk drive interface card. 4) If you heard a loud pop when you turned the Apple power on you have probably mismatched the pins on the interface card. Serious damage has probably been done to your disk drive(s). See an authorized service person.
VIDEODISC PRESENTS INSTRUCTION, BUT DOESN'T ACCEPT INPUT FROM THE TOUCH SCREEN	Check to see that touch panel control box is plugged in, turned on, ribbon colored cable is plugged into the box, baud select is on #2 (see page **54**) and be sure the 25 pin connector is plugged into the LINE connection. The other end of the cable should be connected to the VMI board in slot #4.
TELEVISION SHOWS SNOW AND MAKES NOISE	Check to see that the LINE button on the front of the monitor is pushed in.
COLOR IS INACCURATE	Adjustments in picture color, brightness and hue can be made on this monitor like any television set.

APPENDIX C

SCOPE AND SEQUENCE

SCOPE AND SEQUENCE

STRAND 1: NUMERATION
SECTION 0: NUMBER RECOGNITION

01/00/01/01	Match pattern of shapes
01/00/02/01	Identify groups that are equal by matching like models one to one
01/00/03/01	Identify groups that have more
01/00/04/01	Identify groups that have less
01/00/05/01	Identify numeral which corresponds with objects in a group (<10)
01/00/06/01	Match a group of objects with a numeral
01/00/07/01	Identify a numeral which corresponds with number of objects in a group (>10)
01/00/08/01	Identify ordinal numbers
01/00/09/01	Match number words from 0 to 10 with numerals
01/00/10/01	Identify numerals from 0 to 10 in sequence
01/00/11/01	Identify numerals from 0 to 30 in sequence
01/00/12/01	Identify numerals from 0 to 60 in sequence
01/00/13/01	Identify numerals from 1 to 100 in sequence
01/00/14/01	Identify numeral patterns of 10's
01/00/15/01	Identify numeral patterns of 5's
01/00/16/01	Identify numeral patterns of 2's
01/00/17/02	Identify numbers in sequence to 999
01/00/18/02	Identify patterns of 100's
01/00/19/02	Identify patterns of 10's
01/00/20/02	Identify patterns of 5's
01/00/21/02	Identify patterns of 2's
01/00/22/02	Identify patterns of odd numbers
01/00/23/02	Identify patterns of even numbers

STRAND 1: NUMERATION
SECTION 1: GREATER THAN, LESS THAN

01/01/01/01	Identify symbol < by comparing sets
01/01/02/01	Identify symbol > by comparing sets
01/01/03/01	Identify numbers that illustrate <
01/01/04/01	Identify numbers that illustrate >
01/01/05/01	Compare numbers to 99 using = symbol
01/01/06/01	Compare numbers to 99 using > symbol
01/01/07/01	Compare numbers to 99 using < symbol
01/01/08/01	Compare numbers to 999 using = symbol
01/01/09/01	Compare numbers to 999 using > symbol
01/01/10/01	Compare numbers to 999 using < symbol

STRAND 1: NUMERATION
SECTION 2: PLACE VALUE

01/02/01/01	Identify groups of ten objects
01/02/02/01	Identify objects regrouped in groups of ten
01/02/03/01	Identify objects grouped by 10's and extra objects
01/02/04/01	Identify number of 10's and 1's to 30 with groups of objects
01/02/05/01	Identify number of 10's and 1's to 60 with groups of objects
01/02/06/01	Identify number of 10's and 1's to 100 with groups of objects
01/02/07/01	Count to 100 by 10's
01/02/08/02	Match number with model of 100's, 10's and 1's
01/02/09/03	Match number words with model representing numbers to 999
01/02/10/03	Match numeral with number words to 9,999
01/02/11/03	Match numeral with model representing numbers to 9,999
01/02/12/03	Match numeral with number words to 99,999
01/02/13/04	Match number words to a model representing numerals to 999,999
01/02/14/04	Match numerals to a model representing numbers to 999,999
01/02/15/04	Match number words to a model representing numbers to 9,999,999
01/02/16/04	Match numeral with number words to 9,999,999

STRAND 2: WHOLE NUMBERS
SECTION 0: ADDITION

02/00/01/01	Combine two groups of objects into one group to 9
02/00/02/01	Add horizontally to 9 using objects
02/00/03/01	Add vertically to 9 using objects
02/00/04/01	Identify horizontal addition problems to 9 using model
02/00/05/01	Identify vertical addition problems to 9 using model
02/00/06/01	Add numbers in three groups horizontally
02/00/07/01	Add numbers in three groups vertically
02/00/08/01	Add three numbers by adding two numbers equaling 10 then adding the third
02/00/09/02	Add horizontally to 20 using a model
02/00/10/02	Add vertically to 20 using a model
02/00/11/02	Add two digit numbers without regrouping
02/00/12/02	Add three digit numbers without regrouping
02/00/13/03	Add one and two digit numbers to 99 with regrouping using model
02/00/14/03	Add two digit numbers to 99 with regrouping
02/00/15/03	Add three digit numbers to 999 with regrouping
02/00/16/03	Add numbers to four digits with regrouping

STRAND 2: WHOLE NUMBERS
SECTION 1: SUBTRACTION

02/01/01/01	Subtract objects from a group and count remaining objects
02/01/02/01	Subtract horizontally using objects, - and = signs
02/01/03/01	Subtract vertically using objects and - sign
02/01/04/01	Identify horizontal subtraction problems to 9 using a model
02/01/05/01	Identify vertical subtraction problems to 9 using a model
02/01/06/02	Identify horizontal subtraction problems to 20 with model
02/01/07/02	Identify vertical subtraction problems to 20 with model
02/01/08/02	Complete horizontal subtraction problems to 20
02/01/09/02	Complete vertical subtraction problems to 20
02/01/10/02	Subtract two digit numbers without regrouping
02/01/11/02	Subtract one digit number from two digit number with regrouping with model
02/01/12/02	Subtract a two digit number from a two digit number with regrouping with model
02/01/13/02	Subtract two digit number from two digit number with regrouping
02/01/14/02	Subtract three digit numbers with two regroupings
02/01/15/03	Subtract a two digit number from a three digit number with regrouping
02/01/16/03	Subtract four digit numbers with three regroupings
02/01/17/03	Subtract regrouping thousands
02/01/18/03	Subtract regrouping with 0

STRAND 2: WHOLE NUMBERS
SECTION 2: ADDITION AND SUBTRACTION

02/02/01/01	Identify addition problems from 0-9 with model
02/02/02/01	Identify subtraction problems from 0-9 with model
02/02/03/01	Identify vertical addition problems with model
02/02/04/01	Identify vertical subtraction problems with model
02/02/05/01	Add number combinations to 9
02/02/06/01	Subtract number combinations to 9
02/02/07/01	Identify horizontal addition problems to 20 with model
02/02/08/01	Identify horizontal subtraction problems to 20 with model
02/02/09/01	Identify vertical addition problems to 20 with model
02/02/10/01	Identify vertical subtraction problems to 20 with model
02/02/11/01	Add horizontally to 20 with model
02/02/12/01	Subtract horizontally to 20 with model
02/02/13/01	Add vertically to 20 with model
02/02/14/01	Subtract vertically to 20 with model
02/02/15/01	Add horizontally to 99 with model
02/02/16/01	Subtract horizontally to 99 with model
02/02/17/01	Add vertically to 99 with model
02/02/18/01	Subtract vertically to 99 with model
02/02/19/01	Add two digit numbers to 99
02/02/20/01	Subtract two digit numbers to 99
02/02/21/02	Add two digit number to one digit number with regrouping with model
02/02/22/02	Add two digit numbers with regrouping with model
02/02/23/02	Add two digit numbers with regrouping

02/02/24/02	Subtract one digit number from two digit number with regrouping with model
02/02/25/02	Subtract two digit numbers with regrouping with model
02/02/26/02	Subtract two digit numbers with regrouping
02/02/27/02	Identify missing addend with model
02/02/28/02	Identify missing subtrahend with model
02/02/29/02	Three digit addition problems to 999 with regrouping with model
02/02/30/02	Three digit subtraction problems to 999 with regrouping with model
02/02/31/03	Add three digit numbers with regrouping
02/02/32/03	Subtract three digit numbers with regrouping

STRAND 2: WHOLE NUMBERS
SECTION 3: MULTIPLICATION

02/03/01/02	Identify multiplication problem with model
02/03/02/02	Complete multiplication problem with model
02/03/03/02	Complete multiplication problem using x and = signs with model
02/03/04/02	Multiply horizontally with model
02/03/05/02	Multiply vertically with model
02/03/06/02	Multiply to 100 with model
02/03/07/02	Identify missing number in multiplication problem with model
02/03/08/02	Determine which factors, from 2-9, are multiplied together to give answer
02/03/09/03	Multiply a two digit number by a one digit number without regrouping
02/03/10/03	Multiply a two digit number by a one digit number with regrouping with model
02/03/11/03	Multiply a two digit number by a one digit number with regrouping
02/03/12/04	Multiply two digit numbers with regrouping with model
02/03/13/04	Multiply two digit numbers with regrouping
02/03/14/04	Multiply one digit times 10
02/03/15/04	Multiply one digit times 100
02/03/16/04	Multiply one digit times 1000
02/03/17/04	Multiply whole numbers times multiples of 10
02/03/18/04	Multiply whole numbers times multiples of 100
02/03/19/04	Multiply whole numbers times multiples of 1000

STRAND 2: WHOLE NUMBERS
SECTION 4: DIVISION

02/04/01/02	Identify division problems using / and = signs with objects
02/04/02/02	Complete division problems with object
02/04/03/02	Complete division problem using / and = signs with objects
02/04/04/03	Identify missing dividend
02/04/05/03	Divide three digit number by one digit number
02/04/06/03	Divide three digit number by two digit number
02/04/07/04	Divide three digit number by one digit number with remainder
02/04/08/04	Divide four digit number by two digit number

STRAND 2: WHOLE NUMBERS
SECTION 5: MULTIPLICATION AND DIVISION

02/05/01/03	Identify multiplication problem with model
02/05/02/03	Identify division problem with model
02/05/03/04	Identify multiplication and division problems with model
02/05/04/04	Identify two digit by one digit multiplication and division problems with model
02/05/05/04	Identify three digit by one digit multiplication and division problems with model

STRAND 3: FRACTIONS
SECTION 0: FRACTIONS

03/00/01/03	Identify objects divided in halves
03/00/02/03	Identify objects divided in thirds
03/00/03/03	Identify groups of objects divided into thirds
03/00/04/03	Match model with corresponding fraction
03/00/05/03	Match fraction with model
03/00/06/03	Match equivalent fractions with model
03/00/07/03	Compare size relationships between two fractions with model
03/00/08/03	Match set with fraction
03/00/09/03	Match fraction with object divided in halves
03/00/10/03	Identify equivalent fractions with model
03/00/11/03	Identify equivalent fractions
03/00/12/03	Match fraction with equivalent model
03/00/13/04	Match fraction with fractional part of group
03/00/14/04	Add fractions with model
03/00/15/04	Subtract fractions with model

STRAND 4: DECIMALS
SECTION 0: DECIMALS

04/00/01/03	Determine the value of decimal to the tenths place with model
04/00/02/03	Identify model of decimal fractions to the tenths place
04/00/03/03	Determine the value of decimal to the hundredths place with model
04/00/04/03	Identify model of decimal fraction to hundredths place
04/00/05/03	Identify number words for decimal model to tenths place
04/00/06/03	Identify number words for decimal mode to hundredths place
04/00/07/03	Add tenths
04/00/08/03	Add hundredths
04/00/09/03	Subtract tenths
04/00/10/03	Subtract hundredths
04/00/11/03	Determine the value of decimal using place value chart

STRAND 5: MEASUREMENT
SECTION 0: NONSTANDARD MEASUREMENT

05/00/01/02	Determine length of object using non-standard unit of measurement
05/00/02/02	Order objects measured with non-standard unit of measurement
05/00/03/02	Determine perimeter using non-standard unit of measurement
05/00/04/02	Solve addition problems using non-standard unit of measurement (length)
05/00/05/02	Solve subtraction problems using non-standard unit of measurement (length)
05/00/06/03	Determine area of rectangle using non-standard square units of measurement
05/00/07/03	Count non-standard units in area of rectangle
05/00/08/04	Determine perimeter of polygon using non-standard unit
05/00/09/04	Solve addition problems using non-standard unit of measurement
05/00/10/04	Solve subtraction problems using non-standard unit of measurement

STRAND 5: MEASUREMENT
SECTION 1: MONEY

05/01/01/01	Identify a penny
05/01/02/01	Identify a nickel
05/01/03/01	Identify a dime
05/01/04/01	Identify a quarter
05/01/05/01	Determine value of penny in cents
05/01/06/01	Determine value of nickel in cents
05/01/07/01	Determine value of dime in cents
05/01/08/01	Determine value of quarter in cents
05/01/09/01	Identify combination of coins equal to a nickel
05/01/10/01	Identify combination of coins to equal a dime
05/01/11/01	Identify combination of coins equal to a quarter
05/01/12/02	Identify combination of coins equal to a half dollar
05/01/13/02	Identify combination of coins equal to a dollar
05/01/14/02	Identify combination of coins necessary to buy an item
05/01/15/02	Compare value of coins using < > and =
05/01/16/02	Solve addition problems using ¢ symbol
05/01/17/02	Solve subtraction problems using $ symbol
05/01/18/02	Identify correct change
05/01/19/03	Match coins with coin names
05/01/20/03	Identify value of set of bills and coins
05/01/21/03	Identify steps in counting change
05/01/22/03	Determine amount of bills and coins necessary to purchase an item
05/01/23/03	Solve addition problems using money
05/01/24/03	Solve subtraction problems using money
05/01/25/04	Identify bills to $20.00

05/01/26/04	Identify correct change to $20.00
05/01/27/04	Identify equivalent use of ¢ and $
05/01/28/04	Match monetary word names to amount of money

STRAND 5: MEASUREMENT
SECTION 2: TIME

05/02/01/01	Identify minute hand
05/02/02/01	Identify hour hand
05/02/03/01	Identify the hour
05/02/04/02	Identify the half hour
05/02/05/02	Identify the quarter hour
05/02/06/02	Identify five minute intervals
05/02/07/02	Identify one hour later
05/02/08/02	Identify one half hour later
05/02/09/03	Match clock with written time
05/02/10/04	Identify time to nearest minute
05/02/11/04	Determine appropriate use of a.m./p.m.

STRAND 5: MEASUREMENT
SECTION 3: TEMPERATURE

05/03/01/03	Match written temperature with thermometer (> 0)
05/03/02/03	Identify boiling point on Celsius thermometer
05/03/03/03	Identify freezing point on Celsius thermometer
05/03/04/04	Match written temperature with thermometer (< 0)
05/03/05/04	Identify normal body temperature on Celsius thermometer
05/03/06/04	Identify temperature above or below the comfort zone

STRAND 5: MEASUREMENT
SECTION 4: LENGTH AND AREA

05/04/01/02	Identify object's length to the nearest inch
05/04/02/02	Identify object's length to the nearest foot
05/04/03/02	Identify line segment's length to the nearest inch
05/04/04/03	Identify symbol for one half inch
05/04/05/03	Identify line segment's length to nearest half inch
05/04/06/03	Identify object's length to nearest half inch
05/04/07/04	Identify object's length to nearest eigth inch
05/04/08/04	Identify area in square inches
05/04/09/04	Identify area in square feet
05/04/10/04	Identify area in square yards
05/04/11/04	Determine equivalence of yards and inches

STRAND 5: MEASUREMENT
SECTION 5: WEIGHT

05/05/01/01	Identify objects weight using non-standard unit
05/05/02/01	Identify objects weight to the nearest gram
05/05/03/02	Identify objects weight to the nearest pound
05/05/04/03	Determine appropriate use of ounces
05/05/05/03	Determine appropriate use of pounds
05/05/06/03	Determine appropriate use of tons

STRAND 5: MEASUREMENT
SECTION 6: VOLUME

05/06/01/03	Compare size of cup, pint, quart and gallon
05/06/02/03	Identify equivalent measures of volume
05/06/03/03	Convert between cups and quarts
05/06/04/03	Convert between pints and quarts
05/06/05/03	Convert between quarts and gallons
05/06/06/04	Convert between cups and gallons
05/06/07/04	Solve addition problems using liquid units
05/06/08/04	Solve subtraction problems using liquid units

STRAND 5: MEASUREMENT
SECTION 7: METRIC LENGTH

05/07/01/02	Identify symbol for centimeter
05/07/02/02	Identify symbol for meter
05/07/03/02	Identify objects length to nearest centimeter
05/07/04/02	Identify objects length to nearest meter
05/07/05/03	Identify objects length to nearest millimeter
05/07/06/03	Convert meters to centimeters
05/07/07/03	Convert kilometers to decimeters
05/07/08/03	Solve addition problems converting units
05/07/09/03	Solve subtraction problems converting units

STRAND 5: MEASUREMENT
SECTION 8: METRIC MEASUREMENT

05/08/01/02	Identify objects weight to nearest gram
05/08/02/02	Identify objects weight to nearest kilogram
05/08/03/02	Determine appropriate use of liters
05/08/04/03	Determine area of rectangle using square centimeters
05/08/05/03	Determine area of rectangle using square meters
05/08/06/03	Determine appropriate metric unit to measure area
05/08/07/03	Solve addition problems using square centimeters
05/08/08/03	Solve subtraction problems using square centimeters
05/08/09/04	Determine appropriate use of grams
05/08/10/04	Determine appropriate use of kilograms
05/08/11/04	Determine appropriate use of metric tons
05/08/12/04	Determine appropriate unit to measure objects weight
05/08/13/04	Determine appropriate use of milliliter
05/08/14/04	Determine appropriate unit to measure volume

STRAND 6: GEOMETRY
SECTION 0: GEOMETRY

06/00/01/01	Match circular shapes
06/00/02/01	Match cylindrical shapes
06/00/03/01	Match square shapes
06/00/04/01	Match pyramid shapes
06/00/05/01	Match conical shapes
06/00/06/01	Determine if a shape is two dimensional or three dimensional
06/00/07/01	Identify the number of sides of a figure
06/00/08/01	Identify the number of corners of a figure
06/00/09/01	Identify points that are inside a figure
06/00/10/01	Identify points that are outside a figure
06/00/11/01	Identify points that are on a figure
06/00/12/02	Identify a picture of a line segment
06/00/13/02	Identify a picture of a ray
06/00/14/02	Identify a picture of a line
06/00/15/02	Identify a picture of a right angle
06/00/16/03	Identify a picture of a point
06/00/17/03	Identify a picture of perpendicular lines
06/00/18/03	Identify a picture of parallel lines
06/00/19/03	Identify a picture of an angle
06/00/20/03	Identify a picture of a side
06/00/21/03	Identify a picture of a vertex
06/00/22/03	Identify a picture of a straight angle
06/00/23/03	Identify a symmetrical figure

STRAND 6: GEOMETRY
SECTION 1: TWO DIMENSIONAL FIGURES

06/01/01/02	Identify a square
06/01/02/02	Identify a circle
06/01/03/02	Identify a rectangle
06/01/04/03	Identify a triangle
06/01/05/03	Identify a pentagon
06/01/06/03	Identify a hexagon
06/01/07/03	Identify an octagon
06/01/08/03	Identify a circle's center
06/01/09/03	Identify the radius of a circle
06/01/10/03	Identify the diameter of a circle

STRAND 6: GEOMETRY
SECTION 2: THREE DIMENSIONAL FIGURES

06/02/01/03	Identify a picture of a cube
06/02/02/03	Identify a picture of a pyramid
06/02/03/03	Identify a picture of a rectangular solid
06/02/04/03	Identify a picture of a sphere
06/02/05/03	Identify a picture of a cylinder
06/02/06/03	Identify a picture of a cone

STRAND 7: GRAPHING AND PREDICTIONS
SECTION 0: PICTURE GRAPHS

07/00/01/03	Interpret symbols on picture graphs (vertical)
07/00/02/03	Interpret symbols on picture graphs (horizontal)
07/00/03/03	Compare information on picture graphs
07/00/04/03	Order picture graph information
07/00/05/04	Interpret a picture graph that has half symbols
07/00/06/04	Compare the information on a picture graph with half symbols
07/00/07/04	Order the information on a picture graph with half symbols

STRAND 7: GRAPHING AND PREDICTIONS
SECTION 1: BAR GRAPHS

07/01/01/03	Interpret information on a bar graph
07/01/02/03	Compare information on a bar graph
07/01/03/03	Order information on a bar graph

STRAND 7: GRAPHING AND PREDICTIONS
SECTION 2: TABLES

07/02/01/03	Interpret information on a table
07/02/02/03	Compare information on a table
07/02/03/03	Order information on a table

STRAND 7: GRAPHING AND PREDICTIONS
SECTION 3: ORDERED PAIRS/LINE GRAPHS

07/03/01/03	Identify vertical axis on a line graph
07/03/02/03	Identify starting point on a line graph
07/03/03/03	Identify horizontal axis on a line graph
07/03/04/03	Identify position of ordered pair on graph
07/03/05/04	Interpret information on a line graph
07/03/06/04	Compare information on a line graph
07/03/07/04	Order information on a line graph

APPENDIX D

TRAINING SCRIPT

Student Training

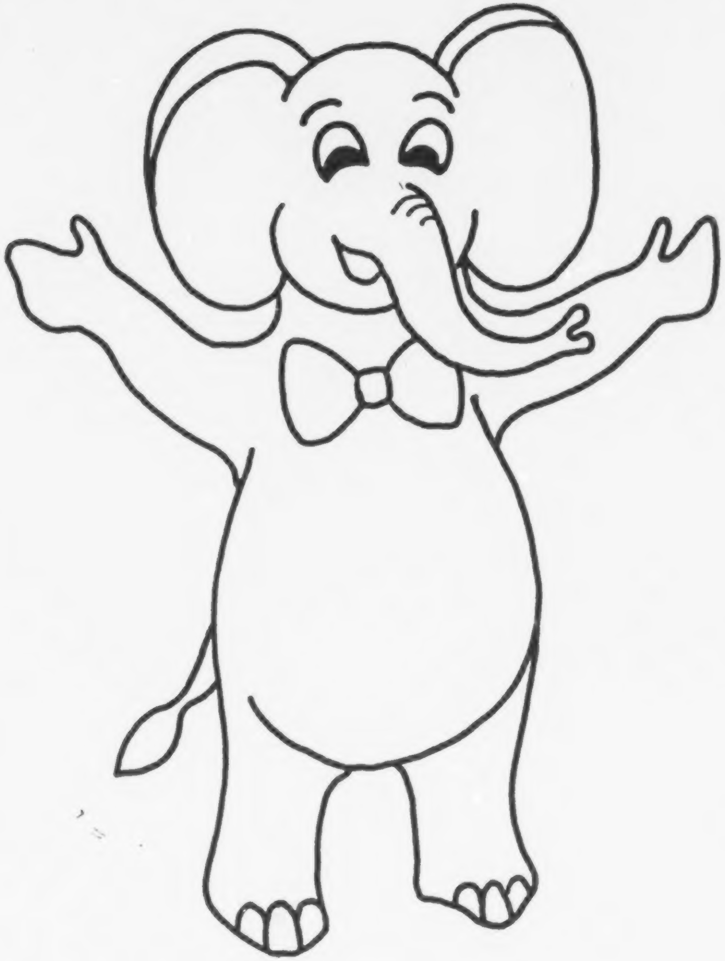
Introduction

To ensure valid test results and accurate record keeping it is EXTREMELY important that students be trained in proper interaction with the system. The following training script will assist you in preparing students to properly respond to the assessment. The training session should take 10-15 minutes.

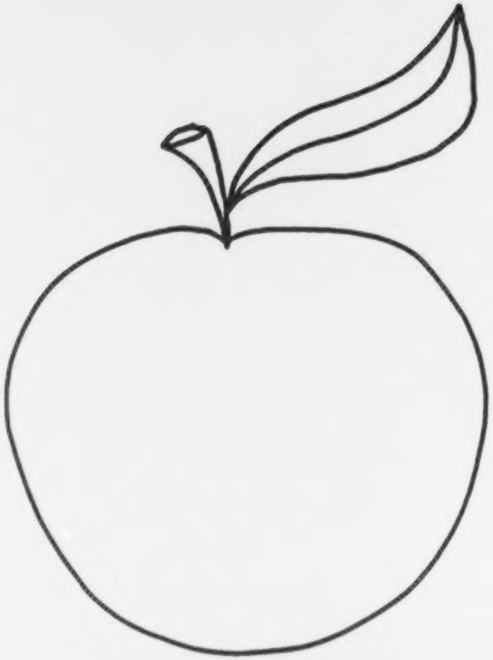
TEACHER DIRECTIONS	DESIRED RESPONSE
"TODAY WE'RE GOING TO DO SOME MATH PROBLEMS. TO DO THESE PROBLEMS YOU'LL NEED A PAPER AND PENCIL. YOU WON'T NEED THEM TO WRITE DOWN THE ANSWERS TO THE PROBLEMS, BUT SOMETIMES YOU MAY NEED THEM TO FIGURE OUT THE ANSWERS."	
DISPLAY GRAPHIC A	
"THIS IS ELMO. WHENEVER YOU SEE ELMO HE'LL TELL YOU WHAT WE'RE GOING TO DO NEXT. BE SURE TO WATCH FOR HIM AND LISTEN CAREFULLY WHEN YOU SEE HIM. WHAT SHOULD YOU DO WHEN YOU SEE ELMO?"	LISTEN CAREFULLY.
"WE'LL USE THE T.V. TO ANSWER QUESTIONS. ALL YOU HAVE TO DO IS TOUCH THE T.V. SCREEN THE RIGHT WAY. HOW WILL WE ANSWER QUESTIONS?"	TOUCH THE SCREEN THE RIGHT WAY.
DISPLAY GRAPHIC B	
"LET'S PRETEND THAT THIS IS THE T.V. TO ANSWER A QUESTION YOU WOULD TOUCH THE ANSWER BOX OF THE CORRECT ANSWER. DO YOU SEE THE ANSWER BOXES? I'LL SHOW THEM TO YOU. SEE THEY EACH HAVE LETTERS (SAY LETTERS)."	STUDENT TOUCHES THE ANSWER BOX.
TOUCH EACH OF THE FOUR ANSWER BOXES OF GRAPHIC B IN TURN. REMEMBER TO TOUCH THE LETTER. WHEN TOUCHING THE ANSWER BOXES BE SURE TO TOUCH WITH YOUR INDEX FINGER ONLY. MOVE YOUR FINGER STRAIGHT IN TOWARD THE ANSWER BOX AND KEEP IT PERPENDICULAR WITH YOUR OTHER FINGERS IN A FIST, UNTIL THE BEEP.	
DISPLAY GRAPHIC B	
"TO ANSWER A QUESTION YOU JUST TOUCH THE ANSWER BOX WITH THE RIGHT ANSWER. HOW DO YOU ANSWER A QUESTION?"	TOUCH THE ANSWER BOX WITH THE RIGHT ANSWER

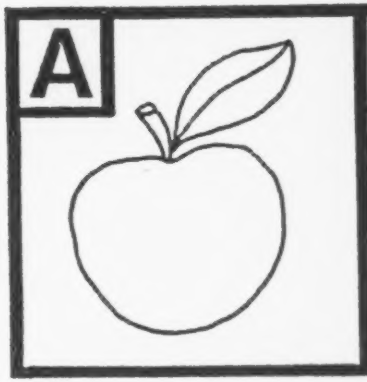
TEACHER DIRECTIONS	DESIRED RESPONSE
DISPLAY GRAPHIC B	
"WHEN YOU ANSWER A QUESTION YOU'LL HEAR A "BEEP". THE "BEEP" MEANS THAT THE COMPUTER KNOWS YOU'VE ANSWERED THE QUESTION. BE SURE AND LISTEN FOR THE "BEEP". WHAT DOES IT MEAN WHEN YOU HEAR A "BEEP".	THE COMPUTER KNOWS I'VE ANSWERED.
DISPLAY GRAPHIC B	
"AFTER YOU HEAR THE "BEEP" YOU MUST TAKE YOUR FINGER OFF THE SCREEN. REMEMBER TO TAKE YOUR FINGER OFF THE SCREEN AFTER YOU HEAR THE "BEEP". WHAT DO YOU DO AFTER YOU HEAR THE "BEEP".	TAKE YOUR FINGER OFF THE SCREEN.
DISPLAY GRAPHIC B	
"NOW LET'S TRY A PRACTICE QUESTION. YOU ANSWER THE QUESTION BY TOUCHING THE SCREEN. I WILL MAKE THE "BEEP". LISTEN...TOUCH THE ANSWER BOX WITH THE APPLE THAT MATCHES THE ONE ABOVE."	STUDENT TOUCHES THE ANSWER BOX OF CORRECT ANSWER, KEEPS FINGER ON BOX UNTIL THE "BEEP", AND REMOVES FINGER AFTER THE BEEP *** NOTE *** IF THE STUDENT PERFORMS ANY OF THE STEPS IMPROPERLY REPEAT THE APPROPRIATE SEGMENT.
DISPLAY GRAPHIC C	
"NOW LET'S TRY ANOTHER. LISTEN...TOUCH THE ANSWER BOX THAT MATCHES THE BEAR ABOVE."	STUDENT COMPLETES TOUCH SEQUENCE CORRECTLY.
DISPLAY GRAPHIC D OR USE THE KEYBOARD	
"SOMETIMES YOU MAY NEED TO HEAR A QUESTION AGAIN. IF YOU DO, PRESS THE LONG BAR. WATCH ME." (DEMONSTRATE ON GRAPHIC).	

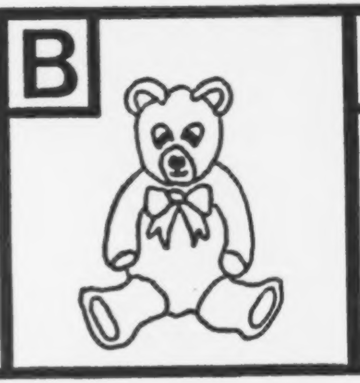
TEACHER DIRECTIONS	DESIRED RESPONSE
DISPLAY GRAPHIC D OR USE THE KEYBOARD	
"NOW SHOW ME WHAT TO DO IF YOU NEED TO HEAR A QUESTION AGAIN."	STUDENT TOUCHES SPACE BAR.
"REMEMBER THOUGH, YOU CAN ONLY HEAR A QUESTION AGAIN ONCE SO LISTEN CAREFULLY. HOW MANY TIMES CAN YOU HEAR A QUESTION AGAIN?"	ONCE.
"IF YOU'RE THINKING ABOUT YOUR ANSWER AND YOU HEAR A "BEEP", DON'T WORRY. THAT'S ELMO REMINDING YOU TO ANSWER THE QUESTION. AFTER YOU HEAR THE BEEP YOU'LL ONLY HAVE A LITTLE MORE TIME TO ANSWER. IF YOU'RE THINKING ABOUT A QUESTION AND HEAR A "BEEP" WHAT DOES IT MEAN?"	ONLY A LITTLE MORE TIME TO ANSWER.
"IF YOU TAKE TOO LONG TO ANSWER A QUESTION WE'LL GO ON TO THE NEXT ONE. IF THAT HAPPENS DON'T WORRY JUST ANSWER THE NEXT QUESTION. WHAT HAPPENS IF YOU TAKE TO LONG TO ANSWER A QUESTION?"	GOES ON TO NEXT ONE.
"IT'S IMPORTANT THAT YOU TRY TO ANSWER EVERY QUESTION. IF A QUESTION IS TOO HARD AND YOU DON'T KNOW THE ANSWER, THEN YOU SHOULD MAKE YOUR BEST GUESS. WHAT SHOULD YOU DO IF YOU DON'T KNOW AN ANSWER?"	TAKE A GUESS.
"KEEP DOING PROBLEMS UNTIL ELMO TELLS YOU TO STOP AND CALLS FOR ME. THEN I'LL TELL YOU WHAT TO DO NEXT. HOW LONG SHOULD YOU ANSWER QUESTIONS?"	UNTIL TOLD TO STOP.
DISPLAY GRAPHIC E OR POINT TO THE DISK DRIVE	
"SOMETIMES WHEN YOU START TO WORK WITH THE COMPUTER THIS BOX, THE DISK DRIVE, WILL MAKE A NOISE AND THE LIGHTS WILL COME ON. THAT'S JUST THE COMPUTER WORKING. WHEN THAT HAPPENS DON'T PAY ATTENTION. WHAT SHOULD YOU DO WHEN THE COMPUTER MAKES A NOISE?"	IGNORE IT.

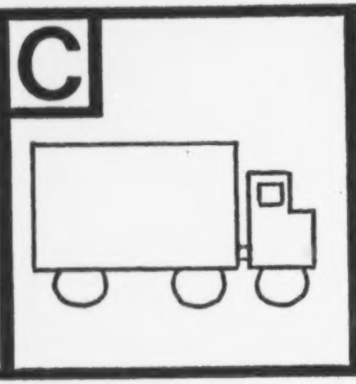


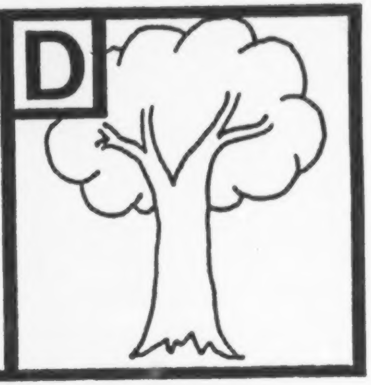
Training Graphic A











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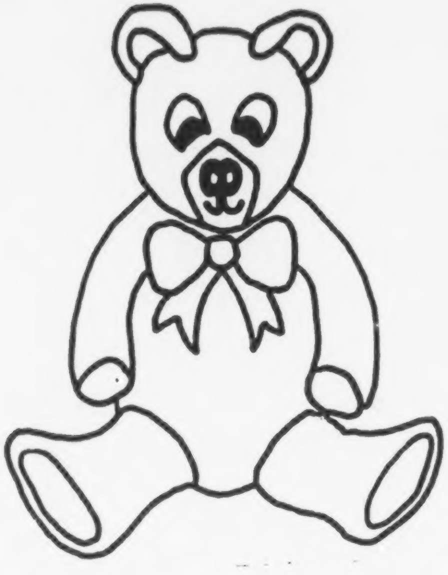

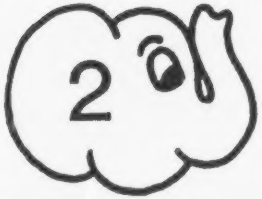

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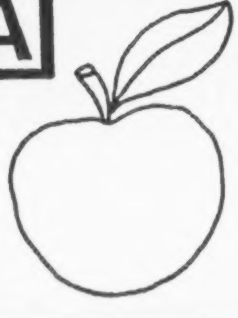
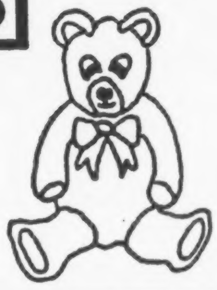


B



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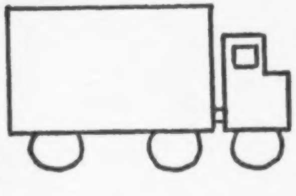

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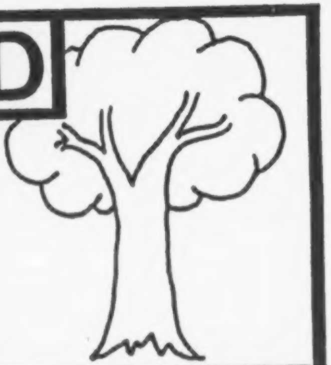
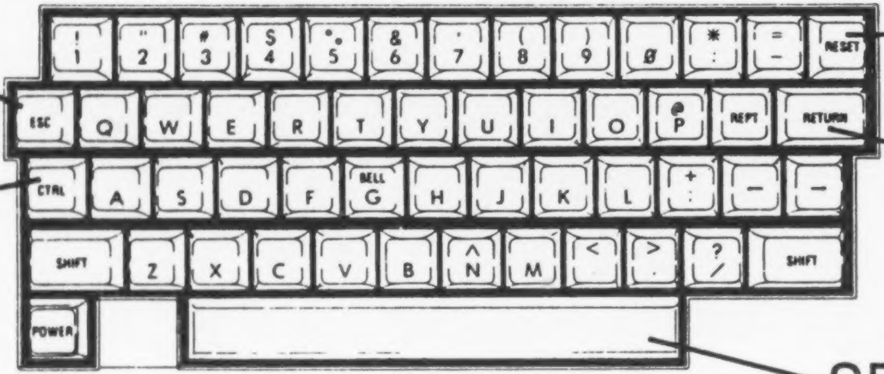


Training Graphic C

IVSET QUICK REFERENCE SHEET

APPLE I I PLUS


ESCAPE
RESET
CONTROL
RETURN
SPACE BAR

CONTROL RESET - Restarts the computer without turning the power off.

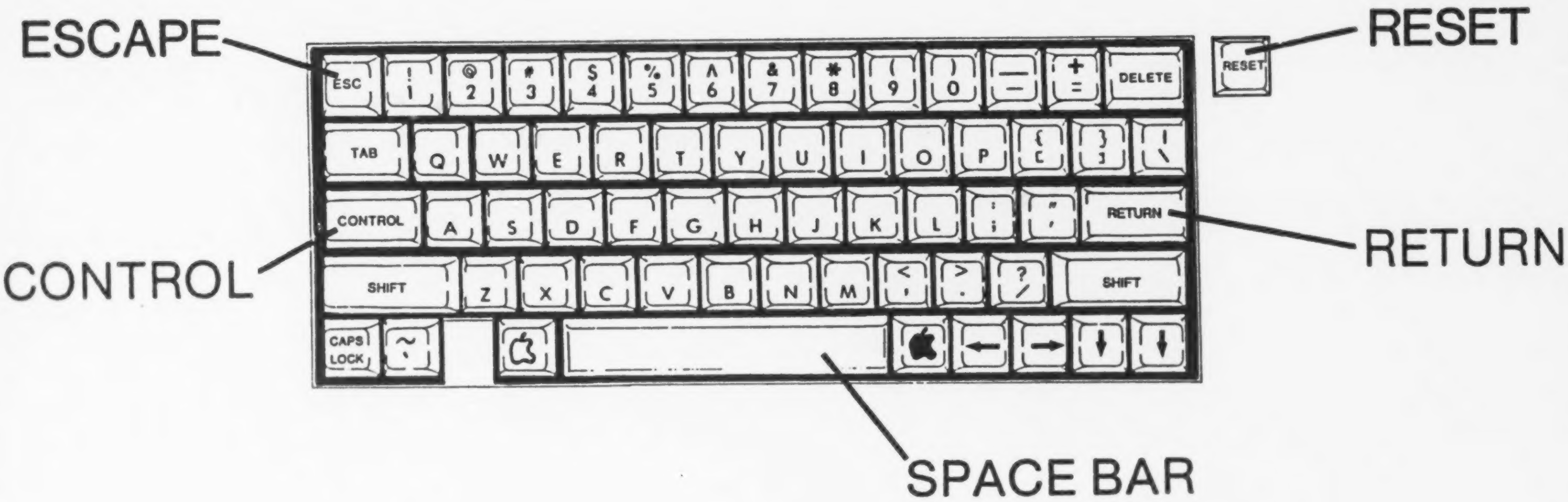
CONTROL A - Switches characters you type on screen from lower case to upper case and visa versa.

E - Ends a session before the specified session length is up.

Training Graphic D$_1$

IVSET QUICK REFERENCE SHEET

APPLE II-E

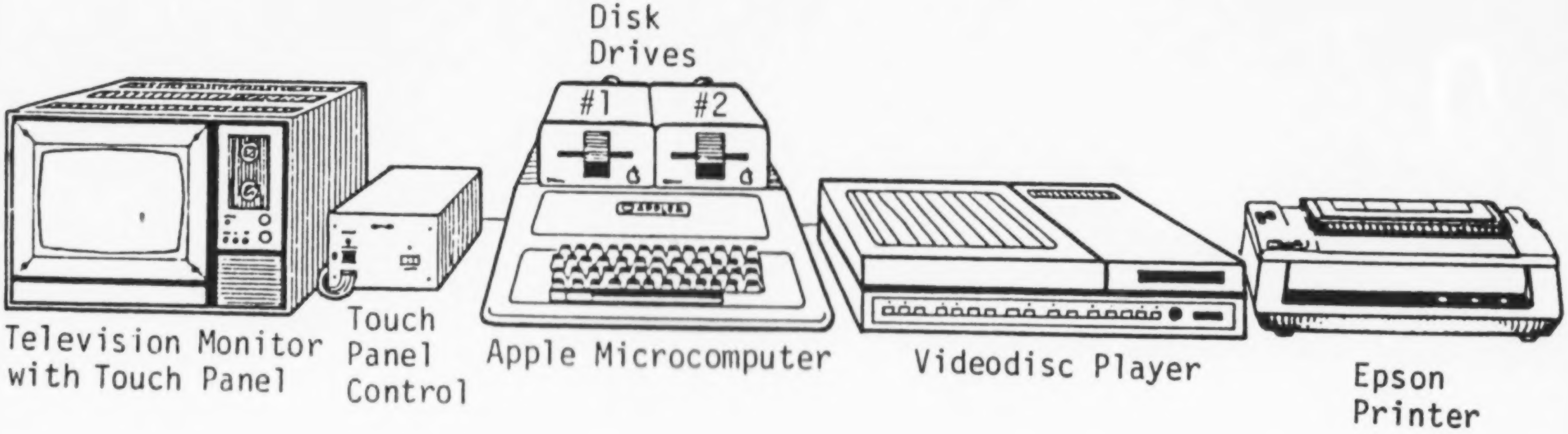

ESCAPE
RESET
CONTROL
RETURN
SPACE BAR

CONTROL RESET - Restarts the computer without turning the power off.

E - Ends a session before the specified session length is up.

Training Graphic D_2

THE SYSTEM :


Disk Drives
#1
#2
Television Monitor with Touch Panel
Touch Panel Control
Apple Microcomputer
Videodisc Player
Epson Printer

Training Graphic E

APPENDIX E

SUGGESTED RESOURCES

The following programs are possible support materials for drill and practice in basic arithmetic skills. As these programs differ in skills addressed, etc., we recommend that potential users preview packages before use. All programs are for the Apple II or IIe computer.

PROGRAM	VENDOR
Mathware System S	Math City 4040 Palos Verde Drive North Suite 202 Rolling Hills Estates, CA 90274
Milliken Math	Milliken Publishing Company 1100 Research Blvd. St. Louis, MO 63132
Computer Drill and Instruction: Math	Science Research Associates, Inc. 155 North Wacker Drive Chicago, IL 60606
Mathematics Assessment/Prescriptive Edu-Disc	Reader's Digest Services, Inc. Educational Division Pleasantville, NY 10507

Appendix B

Publications Generated in Association with this Research Project

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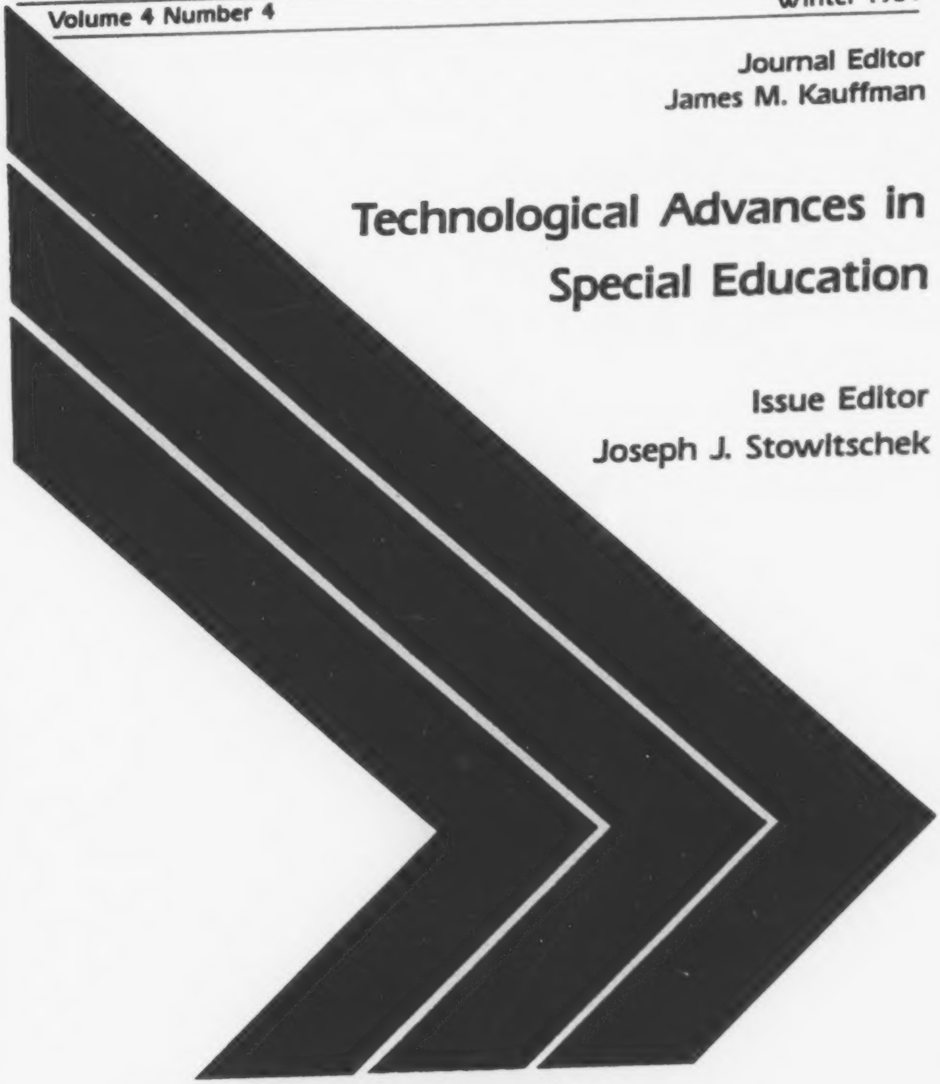
Exceptional Education Quarterly

Volume 4 Number 4
Winter 1984



Journal Editor
James M. Kauffman

Technological Advances in Special Education

Issue Editor
Joseph J. Stowitschek

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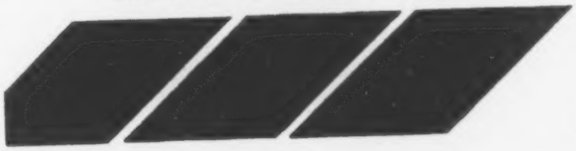

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Microcomputers in Special Education: Implications for Instructional Design

Alan M. Hofmeister and Ron Thorkildsen, *Utah State University*

The development of computer-assisted and computer-managed instruction involves a number of instructional design issues. The implications of these instructional design issues for special education populations are discussed. Reference is made to algorithmic and heuristic procedures, individual rate of learning, feedback, and instructional task hierarchies.

Most educators agree that the information age has arrived and that we in education have a responsibility to take seriously the major tool of the information age—the computer. Although education lags far behind many other segments of society in the application of computers, most educators do not question whether they *should* become involved, but rather they question *how* to become effectively involved in the information age.

In special education there are two major areas of computer activity, one of which is the application of computer technology to the needs of the physically and sensory impaired. The development of a range of electronic devices for individuals with visual, hearing, and motor

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handicaps has contributed significantly to the quality of life of many handicapped individuals. Vanderheiden (1982) sums up these developments as follows:

> The past few years have witnessed a tremendous increase in the number of individuals and small groups involved in the development of special aids for disabled persons. Microcomputers have given individual designers, who don't have access to extensive laboratory and production facilities, the capability of developing sophisticated electronic aids. (p. 136)

The second area of activity in special education has been the general computer literacy of special education teachers and administrators. Special educators, like their colleagues in regular education, are being trained in the use of computers. These programs are preparing them to work with computer applications in education like computer-assisted instruction (CAI), computer-managed instruction (CMI), and the teaching of computer literacy to their pupils.

As special educators become more familiar with the general concepts and practices of computer-assisted instruction (CAI), computer-managed instruction (CMI), and the teaching of computer literacy, they will become concerned about what adaptations have to be made in the computer activities of the regular classroom to meet the needs of the special education population. While the contributions from electronic devices have been exciting and substantial, these devices benefit only approximately 10% of the school-age handicapped—the visually impaired, the deaf, the hard of hearing, the crippled and other health impaired, and the multiply handicapped. The remaining 90% consists of the learning disabled, the speech impaired, the mentally retarded, and the emotionally disturbed (Report to Congress, 1981). Many from this group are in the regular classroom for all or part of the school day.

As the impact of computers on the public schools grows, special educators will most likely have to face the issues of instructional design of computer-related products and of adapting existing instructional products—or designing new products—to meet the needs of special education populations in regular classrooms.

This article draws attention to a number of the instructional design issues involved in the development of computer-assisted instruction and computer-managed instruction products and discusses the implications of these design features for special education.

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Algorithmic and Heuristic Procedures

Currently, *algorithmic procedures* is the main process by which we translate instructional information into a form that the computer can handle. An algorithm is a set of steps to solve a problem. These steps are linked in a logical flow, the basic elements of which are activities, decision points, and loops.

To pinpoint where modifications may be necessary for special education, we need to study each of these basic building blocks. For example, if we wish to add fractions, the first activity may be to identify the existing denominators; the second activity would be to search for a common denominator, etc.

Clearly, the relative complexity of each activity in an algorithm will be an area of concern with special education populations. The often-discussed notion of breaking activities into smaller steps for many special education pupils is obviously one possible approach.

The decision points built into a computer program are another area of concern. In the algorithm, decisions are often made on the basis of the number of errors. If a given activity is failed three successive times, for example, the pupil may be branched back to an earlier activity. Will the formulas that we use for the branching process in regular education apply to special education? If they do not, what ratios of errors to successes should be used? Should programs be designed to allow the teacher to vary the criteria for branching?

The loops that we build into our instructional algorithms generate another series of research questions. In many cases the loops take the individual back to the previous step: Will such short retracing of the instructional path be appropriate in special education? Will we need to go back further or will we need to go to an entirely different set of instructional activities with richer prompts? Clearly, then, we will have to assess all the basic building blocks of the traditional instructional algorithm—the activity, the decision point, and the loop—in terms of the responses of different special education populations.

A *heuristic procedure* is similar to an algorithm in that it is a set of steps linked in a logical flow that involves activities, decision points, and loops. The major difference between an algorithm and a heuristic procedure lies in the nature of the decision points. In an algorithm the decisions are made in a relatively straightforward manner. For example, if the response is correct, we branch to activity *x*. If the response is incorrect, we branch to activity *y*. In a heuristic procedure, on the other hand, the decisions are made on the basis of probability.

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For example, when an incorrect response is given, a heuristic procedure takes into consideration the nature of the subject matter and the responses of previous populations of learners, and deduces from this information that there is a high probability that the individual made a certain type of error. In a subtraction problem, for example, the individual may have forgotten to carry. The possibility exists, of course, that this may not have been the problem. However, if the computer's estimates of probability indicate a relatively high chance that this *was* the problem, then the student is branched to an activity designed to remediate carrying.

Currently, heuristic-based courseware is generally not available except on the faster, more powerful minicomputers. Within the past year, however, several heuristic-based CAI programs have been converted to microcomputer applications, termed *intelligent tutoring systems* (ITS) (Sleeman & Brown, 1982).

One of the issues that arises with heuristic procedures in intelligent tutoring systems is that most of the data used to estimate probabilities is not based on special education pupils. Research should focus on the degree to which these probability estimates work with special education populations.

Individual Rate of Learning

Some proponents of computer-assisted instruction proclaim that one of CAI's great advantages is that it allows individuals to "learn at their own rate." As far as the computer is concerned, this learning process results from two rather complex processes. One of these—the computer's capacity to adjust the flow of instruction based on the responses of the individual—has already been discussed in connection with algorithmic and heuristic procedures. The second process allows the learner to consciously control the flow of instruction. This raises the question of how well prepared the average emotionally disturbed, mentally retarded, or learning disabled special education pupils are to handle this type of independence and instructional responsibility. Considerable evidence in the research literature suggests that this may be a significant problem for regular learners (Alderman, Swinton, & Braswell, 1978).

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Feedback

The computer's ability to provide instant feedback to pupils continues to be a major source of debate among instructional developers. Hofmeister (1983) notes,

> One of the often-mentioned advantages of the computer is its ability to provide feedback instantly. Some observers will first paint a depressing picture of an overworked teacher in an overcrowded classroom trying to give every child individual attention. Then, in sharp and sterile contrast, the observer paints the picture of a classroom with every child at a terminal receiving *instant* feedback after every response. The assumption underlying this comparison is that instant feedback is always better than delayed feedback. (pp. 3–15)

One of the anomalies of the research literature during the past 50 years has been the failure of instructional developers to replicate findings on instant feedback developed in behavioral psychology laboratory settings. Moore and Smith (1961) worked with teaching machines in a sequence of studies on the teaching of spelling and concluded that providing subjects with immediate knowledge of the correct response did not facilitate the learning of spelling. Moore and Smith pointed out, however, that (1) in automated spelling instruction the subjects reached a high level of achievement without the direct involvement of the teacher; (2) compared with traditional instruction, there was a 50% savings in time for all students (and an even greater savings for the bright students); and (3) the teacher had more time for other instructional activities.

The finding that automated instructional procedures were valuable—but not necessarily as a result of immediate feedback—has been replicated several times in succeeding years. Rankin and Trepper (1978) conducted a study in which one group received feedback immediately, one group after a 15-second delay, and the third group at the end of the lesson. During the lesson the participants made few errors, and the researchers reported:

> The short program produced very rapid one-trial learning. This demonstrates the power of an interactive teaching program in assisting the learner to achieve an absolute criterion, even when the material is at a level that produces random responses in the initial trials. (p. 68)

Rankin and Trepper tested all groups immediately after the lesson and then 24 hours later. There was little difference among the groups

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on the test at the end of the lesson. There was, however, a very marked difference on the test of retention. The average scores for the immediate, the 15-second delay, and the after-lesson-feedback group were 40%, 67%, and 84%, respectively. The group receiving immediate feedback was clearly the poorest on retention when measured 24 hours after the lesson. Rankin and Trepper concluded, "The current investigators are of the persuasion that the delay effect is of an empirically validated nature and is the result of multiple and yet undifferentiated causes" (p. 69). It is clear then, that we have much to learn about the process of feedback and its effect on different populations and subject matter areas.

Types of Feedback

Feedback combines with student responses in three ways: (1) *right-wrong* feedback, when feedback follows both the correct and incorrect student responses; (2) *right-blank* feedback, when feedback follows just the correct responses; and (3) *wrong-blank* feedback, when feedback follows the incorrect responses only.

The general types of feedback include (1) verbal (e.g., teacher or machine says or prints "right" or "wrong"), (2) symbolic (e.g., tones, flashing symbols or lights, animations), and (3) tangible (e.g., the teacher or machine dispenses tokens, candy, or money).

In reviewing the research literature on how the types and combinations of feedback effect the conceptual learning of children, Barringer and Gholson (1979) reported as follows:

> In general, the findings have been consistent in two respects: (1) verbal and symbolic feedback produce more rapid acquisition than does tangible feedback; (2) the wrong-blank combination produces faster acquisition and more resistance to extinction than does the right-blank condition. Results yielded by the right-wrong combination have been inconsistent. (p. 459)

Given the fact that very little of this kind of research is being conducted with the different special education populations, and given the fact that the right-wrong combination is both the most common and most inconsistent in terms of outcome, it is clear that special educators must proceed with considerable caution when they select and apply different types of feedback in the development and use of CAI programs.

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Instructional Task Hierarchies

Most approaches to instructional design in CAI and CMI products strongly emphasize the use of task hierarchies. Scandura (1981) advocates empirically-developed hierarchies based on item difficulty as follows:

> Such hierarchies provide a theoretically derived and empirically verified partial ordering (hierarchy) of selected test items, according to difficulty. This difficulty hierarchy has been utilized to provide even more efficient assessment. Once a student has failed at a given level, for example, there is no need to test on tasks at levels below where the student has already succeeded. (p. 17)

Once such hierarchies have been developed, they will be built in to CAI and CMI products. Two questions arise if special education populations are not a part of the empirical base: (1) How well will such hierarchies fit the needs of the different special education populations? (2) If a hierarchy does not fit the needs of special education pupils, will product developers be willing to undertake the expensive field research needed to develop hierarchies based on special education populations and make modifications to products?

Conclusion

The expanding interest in the use of CAI and CMI products in special education raises a host of research questions about the design of such products. Many of these questions will not be easy to answer, requiring research across curriculum areas and special education populations. In the past, attempts at research in such areas have often yielded a morass of nonsignificant findings, largely because levels of instructional intervention are inconsistent.

The highly consistent and portable nature of CAI and CMI products offers the researcher increased precision in replicating intervention. Moreover, should research show that these products are highly successful, CAI and CMI could offer widespread, quality instructional intervention for special education pupils.

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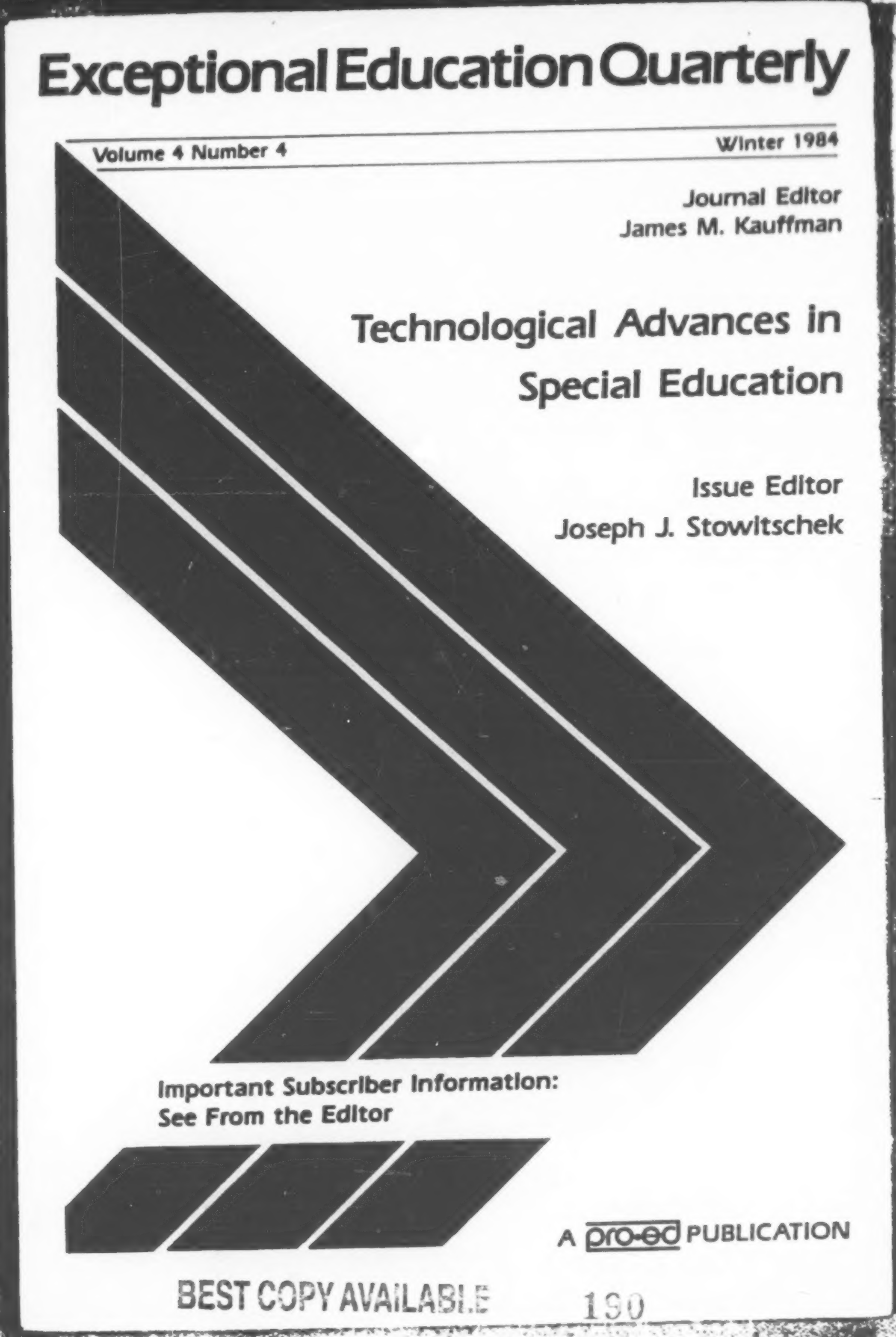

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Interactive Video Authoring of Instruction for the Mentally Handicapped

Ron Thorkildsen and Alan Hofmeister, *Utah State University*

The article describes the development and field testing of a Microcomputer/Videodisc computer assisted instruction system for mentally handicapped students with primary emphasis on the authoring system, which is a set of computer programs designed to allow noncomputer programmers to write instructional programs for use with the Microcomputer/Videodisc system. The objectives of the authoring system were evaluated as part of the overall field tests. Evaluation results are reported along with details on the operational aspects of the authoring system.

Problems that hinder the development of computer assisted instruction (CAI) for mentally handicapped students are amplified by the special needs of this population. One major problem is the paucity of conclusive research on CAI.

A relatively small number of CAI programs have been developed for mentally handicapped learners, and some of these efforts have included research on program effectiveness. The studies that have been done, however, have produced a variety of findings. As an aggregate,

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they are not conclusive (Williams, Thorkildsen, & Crossman, 1983) because of the often unique instructional interactions that occur between a form of media and the curriculum content.

Particularly in special education, CAI is in its infancy. We know little about the kind of instructional design that will maximize the potential of the emerging electronic media. Research is needed on type and frequency of feedback, effective rates of presentation, and effective use of instructional sequencing. That is, we need answers to questions about instructional design of CAI before we ask questions about its effectiveness. When discussing educational research in general, Fred Kerlinger (1977) suggested that more emphasis be placed on why things work rather than if they work. This is particularly true in the evaluation of CAI: We need *formative* evaluation.

The new videodisc technology will open up a range of research possibilities with extensive implications for all modes of instruction, including CAI for the mentally handicapped. It is the quality of simulation available on the videodisc that allows researchers to generalize findings. Never before have educational researchers had access to a tool capable of such quality simulation and on-line data collection at such a low cost. Thus far, research efforts have not taken full advantage of this tool.

Another deficiency of present CAI efforts is the lack of emphasis on concept teaching. Much of the present technology effort is tied to the linear task analysis approaches left over from the early days of programmed instruction. So far we have failed to capitalize on the high speed random access capabilities currently available in computer and videodisc hardware. The early work of Markle and Tiemann (1972) and Engelmann (1969) in concept analysis takes on considerably more significance because current hardware is compatible with their theoretical structures.

Another major problem concerns the match between the population and the technology. Traditional CAI assumes the student has reading skills—not a valid assumption with mentally handicapped students. Consequently, the challenge is to facilitate communication between the computer and the nonreader. Various attempts have been made with speech synthesizers and other audio devices, but the most promising technology currently available is the optical videodisc player.

This article describes the development and field testing of a microcomputer controlled videodisc system designed to alleviate some of the research deficits and the communications problems associated with CAI and mentally handicapped learners. An authoring system

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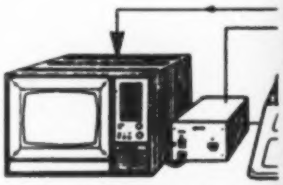

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was developed as part of the project. This system will greatly facilitate the formative evaluation needed to improve the instructional design practices that will produce effective CAI for the mentally handicapped. The authoring system provides a means for educators who do not have computer programming skills to develop CAI and provides a means for collecting very detailed data on the student's response patterns. These data can then be used to investigate instructional options.

IVSET Project

The hardware, software, and instructional programs described here were developed by the staff of the Interactive Videodisc for Special Education Technology Project (IVSET). Funded by a grant from the U.S. Office of Special Education, the project was conducted at Utah State University. Its primary goal was to develop and field test a system to provide Computer Assisted Instruction (CAI) for mentally handicapped students.

The hardware for the Microcomputer/Videodisc (MCVD) system consists of a Pioneer Model 7820 III Videodisc Player, an Apple II microcomputer with two 5¼" floppy disk drives, a SONY 12" color monitor and a Carrol Manufacturing touch panel built into the monitor (see Figure 1).

The videodisc player was selected for its rapid, random access capabilities—a typical search and retrieval of an instruction or feedback segment takes less than one second. The touch panel is a light interrupt system that allows the student to interact with the system by touching the monitor screen. The Apple II controls the system through computer programs and an interface device that plugs into the Apple. Both were designed and developed by IVSET project staff. The videodisc system, which has the aproximate size and appearance of an LP phonograph record, is the storage medium. It is capable of

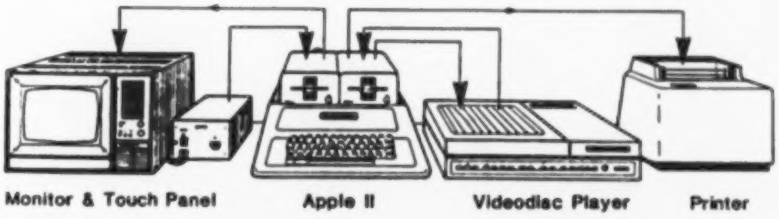

Figure 1. MCVD system configuration.

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storing 54,000 individual frames of video or 30 minutes of audio and motion video on each side. It also has dual audio tracks.

The 7820 III player is the instructional videodisc model, which has its own microprocessor and has rapid random access capabilities. Any position on the videodisc can be accessed and retrieved in less than three seconds. Still frame capabilities as well as the audio and video reproduction are excellent.

The system interacts with the student by presenting an audio instruction and the associated visual image on the monitor. The student responds by touching the image of an object on the monitor screen. When the student touches the screen, two light beams transmitted from each axis of the touch panel are interrupted, and the point of interruptions is detected by the touch panel. The *x* and *y* coordinates are then transmitted to the computer. The computer program in the microcomputer contains the correct coordinates for each segment of instruction. The computer compares the coordinates transmitted by the touch panel to the correct coordinates.

The microcomputer responds to a correct response by finding and retrieving a segment on the videodisc that contains audio and visual feedback. The videodisc also contains recorded segments for incorrect response and no-response conditions as well as a variety of feedback, including animation and motion picture sequences.

Each segment of instruction has associated parameters that specify the number of times a student must respond correctly in order to advance to the next instruction segment. As the student interacts with the system, data are collected by the microcomputer and stored on a floppy disc by the Apple disk drive.

To date, six instructional programs have been developed for use with the MCVD system: (1) Matching Sizes, Shapes and Colors, (2) Time Telling, (3) Identification of Coins, (4) Functional Words, (5) Sight Reading, and (6) Directional Prepositions. The first four programs were field tested with moderately mentally handicapped students, and the latter two were field tested in elementary resource rooms.

Videodisc Authoring System

A major IVSET objective has been to develop a set of computer programs that could be used with any Microcomputer/Videodisc (MCVD) instructional program. This set of programs constitutes a

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general purpose authoring system for a microcomputer-controlled videodisc system, and it was designed to meet the following criteria:

- An instructional programmer with little or no computer experience should be able to use the authoring system to write instructional programs.
- The authoring system should give the instructional developer a high degree of flexibility in presenting instruction from either the microcomputer or the videodisc player.
- The system should collect data for instructional analysis.
- A teacher should be able to use the authoring system.
- The authoring system should summarize student data and present it in a form useful for monitoring student progress.
- The system should collect data on each student response that identifies the item, the type of response (correct or incorrect), and the amount of time to make a response.

The IVSET staff produced a set of general purpose authoring procedures that both teachers and researchers can adapt to most instructional formats, and can use to develop CAI with videodisc material, computer graphics, and text, and to collect, summarize, and present data.

Instructional Scripting Process

In order to explain the functions of the authoring system it is necessary to briefly describe the production events that must occur prior to using the system. After an instructional area has been identified, production of an MCVD instructional program begins by designing instructional sequences in the form of a script. The script addresses both the audio and video aspects of the instructional sequence. A scripting form was devised which specified each of the following:

- The source of the video (videodisc or computer generated graphics).
- The source of the audio (the videodisc has two program selectable audio tracks).
- The type of segment (instruction, remediation, test, or feedback).
- A segment number that is unique for each segment.
- The actual audio and video content of the segment.

Figure 2 illustrates a scripting form containing a segment of instruction from a program designed to teach directional prepositions. When this segment is presented to the student via the MCVD system,

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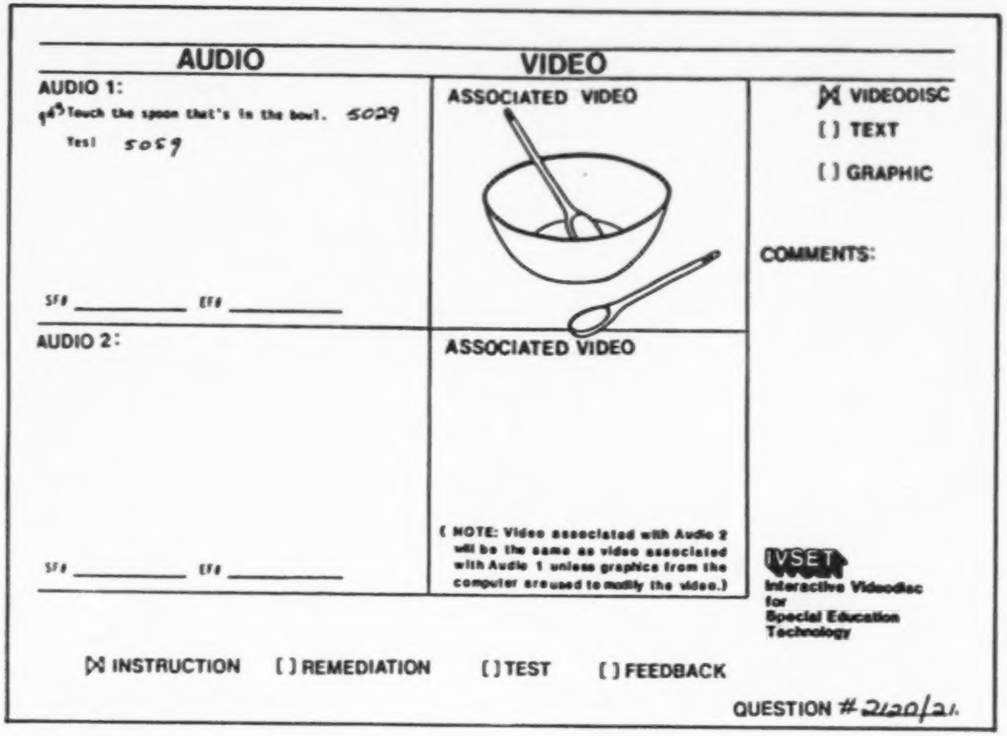

AUDIO	VIDEO	
AUDIO 1: 943 Touch the spoon that's in the bowl. 5029 Test 5059 SF# ______ EF# ______	**ASSOCIATED VIDEO**	☒ VIDEODISC ☐ TEXT ☐ GRAPHIC COMMENTS:
AUDIO 2: SF# ______ EF# ______	**ASSOCIATED VIDEO** (NOTE: Video associated with Audio 2 will be the same as video associated with Audio 1 unless graphics from the computer are used to modify the video.)	IVSET Interactive Videodisc for Special Education Technology

☒ INSTRUCTION ☐ REMEDIATION ☐ TEST ☐ FEEDBACK

QUESTION # 2120/21.

Figure 2. IVSET Scripting Form.

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Using the Authoring S

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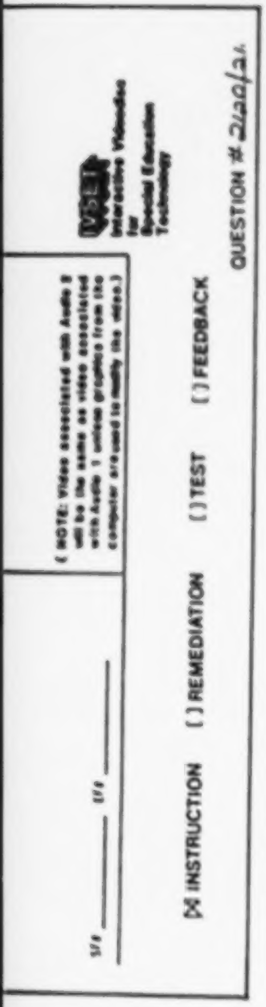

IVSET
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for
Special Education
Technology

QUESTION # 2120/21

(NOTE: Video associated with Audio 2 will be the same as video associated with Audio 1 unless graphics from the computer are used to modify the video.)

S/A ______ S/A ______

☒ INSTRUCTION ( ) REMEDIATION ( ) TEST ( ) FEEDBACK

Figure 2. IVSET Scripting Form.

the bowl and spoons would appear on the monitor screen and the audio would be "Touch the spoon that's in the bowl."

The entire script for the instructional program is written on the scripting forms, including remediation and feedback segments. Thus, the script serves as a production plan. The set must be designed and built, actors identified, and television studio time secured. Prior to studio production, rehearsals are conducted and filmed on ¾" videotape. The videotape is reviewed and necessary revisions are made. If possible, segments of the instruction are tested with students.

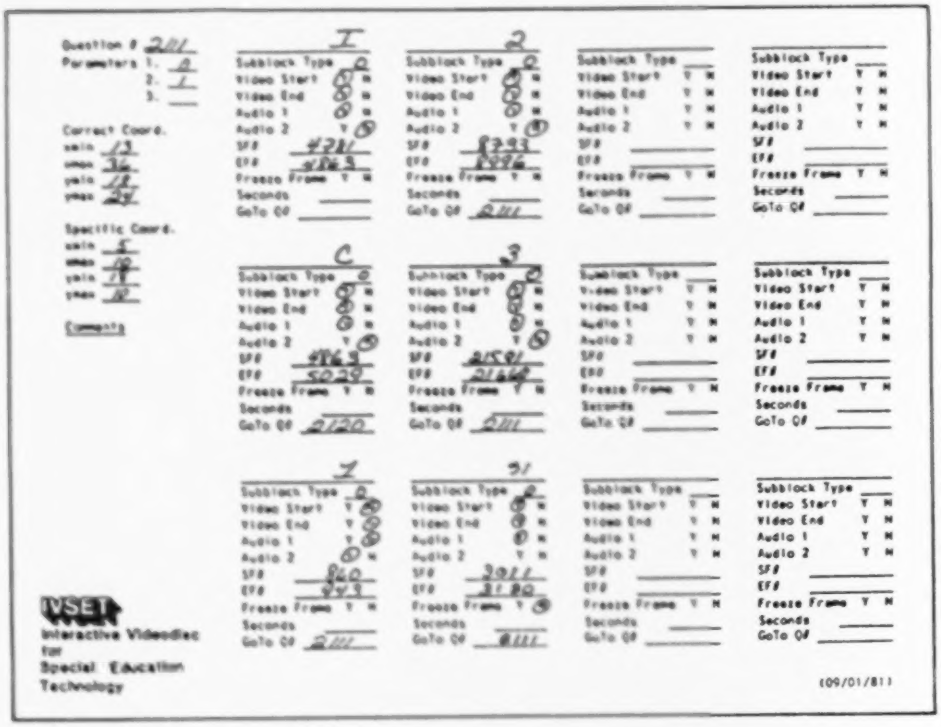
The next step is to conduct the actual studio production. The entire script—including instruction, remediation, feedback, and testing segments—are filmed on 1" videotape. This videotape is then sent to either Pioneer or 3M Corporation to be made into a videodisc, a process referred to as "pressing the videodisc." Currently these are the only companies that offer service of this type in the United States. Videodisc pressing typically takes about six weeks.

Using the Authoring System

Upon receiving the completed videodisc, the beginning and ending frame numbers for each segment on the videodisc must be identified. Additionally, *x* and *y* coordinates are used to locate images on the monitor screen. The coordinates are identified for each segment requiring a student response. For instance, coordinates for the segment represented in Figure 2 would identify both spoons in the locations they appear on the screen. This would elicit (1) positive feedback if the student touched the correct spoon, (2) negative feedback specific to touching the spoon in the bowl, or (3) general negative feedback if the student touched anywhere else on the screen. One of the computer programs from the authoring system assists in the identification and recording of screen coordinates.

Another form, the Programming Form, is used at this point of production to record the frame numbers and coordinates and set up the logic associated with a particular instructional segment. Figure 3 illustrates a Programming Form.
Six of twelve possible subblocks are completed; their functions are:

1. The first subblock, designated by *I*, identifies the instruction segment.



Question # 2111
Parameters 1. 2
2. 1
3. ___

Correct Coord.
xmin 13
xmax 36
ymin 18
ymax 24

Specific Coord.
xmin 5
xmax 10
ymin 18
ymax 10

Comments

	I	2		
Subblock Type	0	0		
Video Start	[✓ Y] N	[✓ Y] N	Y N	Y N
Video End	[✓ Y] N	[✓ Y] N	Y N	Y N
Audio 1	[✓ Y] N	[✓ Y] N	Y N	Y N
Audio 2	Y [✓ N]	Y [✓ N]	Y N	Y N
SF#	4781	8393		
EF#	4863	8496		
Freeze Frame	Y N	Y N	Y N	Y N
Seconds				
GoTo Q#		2111		

	C	3		
Subblock Type	0	0		
Video Start	[✓ Y] N	[✓ Y] N	Y N	Y N
Video End	[✓ Y] N	[✓ Y] N	Y N	Y N
Audio 1	[✓ Y] N	[✓ Y] N	Y N	Y N
Audio 2	Y [✓ N]	Y [✓ N]	Y N	Y N
SF#	4963	21591		
EF#	5029	21648		
Freeze Frame	Y N	Y N	Y N	Y N
Seconds				
GoTo Q#	2120	2111		

	7	91		
Subblock Type	0	2		
Video Start	Y [✓ N]	[✓ Y] N	Y N	Y N
Video End	Y [✓ N]	[✓ Y] N	Y N	Y N
Audio 1	Y [✓ N]	[✓ Y] N	Y N	Y N
Audio 2	[✓ Y] N	Y N	Y N	Y N
SF#	860	3011		
EF#	943	3180		
Freeze Frame	Y N	Y [✓ N]	Y N	Y N
Seconds				
GoTo Q#	2111	8111		

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for
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Figure 3. IVSET Instructional Programming Form.

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3. The next three subblocks,
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presents the statements "
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Program Control

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GOTO Instruction. T
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Each subblock contains a

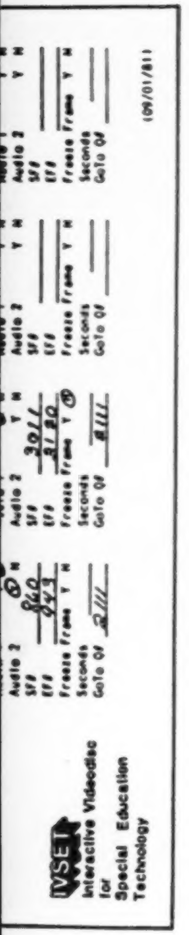
IVSET
Interactive Videodisc for Special Education Technology
Audio 2
SFF
EFF
Freeze Frame Y N
Seconds
GoTo
860
943
2111
3011
2180
8111
09/01/81

Figure 3. IVSET Instructional Programming Form.

2. The second subblock, designated by C, specifies the consequence of a correct response. In this case the word *right* is retrieved and presented orally to the student.
3. The next three subblocks, designated by *1, 2,* and *3,* refer to consequence following the first, second, and third incorrect response. Subblock 1 presents the word *not right*. The second subblock presents the statements "That was a nice try. Watch me. I am touching the spoon that is out of the bowl. Listen again." Subblock 3 activates a buzzer that signals for help from the teacher. It is assumed that help is required after the third incorrect response because the student was given the correct answer after the second incorrect response. After each incorrect response, the initial instruction segment is replayed as indicated in the GOTO entry.
4. The sixth subblock, designated by *S1,* specifies the consequence associated with touching the location on the screen identified by the specific coordinates. In this case, if the student touched the spoon in the bowl, the system responds orally with "No, that is the spoon in the bowl. Touch the spoon out of the bowl." The instruction segment is then repeated. The Programming Form also provides for a number of logic controlling indicators, which are briefly explained in the next section.

Program Control

In addition to those functions previously explained, the system accepts additional logic controlling parameters. These are also specified on the Programming Form. Parameters serve several functions for the instructional programmer. For example, parameter values identify the beginning of the test, indicate the number of responses required in a test, and indicate the number of incorrect responses a student is allowed before failing the test. The parameters let the instructional programmer vary the number of incorrect responses a student is allowed before failing the test or during a particular instruction segment. Another set of parameters instructs the computer to wait or not to wait for a student response. The parameters also instruct the computer to retrieve computer produced text or graphics.

GOTO Instruction. The GOTO instruction indicates the next segment to be executed after the subblock instructions are executed. Each subblock contains a GOTO instruction.

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Subblock Identifiers. Subblock identifiers define the functions of each subblock. The various subblocks include an instruction subblock, correct, incorrect, and specific subblocks. Following is a list of possible subblocks and their identifiers:

I—Instruction
C—Correct
1—1st Incorrect
2—2nd Incorrect
3—3rd Incorrect
4—4th Incorrect
S1—1st Specific Correct or Incorrect
S2—2nd Specific Correct or Incorrect
S3—3rd Specific Correct or Incorrect

The instructional programmer can decide how many, if any, incorrect responses will be allowed.

Subblock Type. Defining subblock types allows the instructional programmer to vary the function of each subblock. The subblock types are currently defined from 0–5 and elicit the following functions:

Subblock Type = 0. Play videodisc frames and execute GOTO instruction.
Subblock Type = 1. Present text from the computer and execute the GOTO instruction.
Subblock Type = 2. Ignore the videodisc frames and execute the GOTO instruction.
Subblock Type = 3. Not currently used.
Subblock Type = 4. Play the videodisc frames, initiate the assistance signal, and execute the GOTO instruction.
Subblock Type = 5. Initiate the assistance signal, inform the user to turn the videodisc over, and execute the GOTO instruction.

Video Flags. The video flags allow the instructional programmer to determine the source of the video. Video start and video end flags require a *yes* or *no* selection. When the video from the videodisc is to play, both video start and video end should be *Y* (Yes). When the video from the videodisc should be blanked out, the video start and video end flags should both be *N* (No).

Audio Flags. The Audio 1 and Audio 2 flags allow the instructional programmer to select either audio track or both audio tracks

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Creating Instructional

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Debugging Data Files

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- Too many *N* flags
- Minumum coordin numbers
- Impossible GOTO
- Starting frame nun

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ack or both audio tracks

programmatically. To play both Audio 1 and Audio 2, both flags should be *Y* (Yes). To play only Audio 1 set the Audio 1 flag to *Y* and Audio 2 to *N* and vice versa.

Starting and Ending Frame Numbers. Specify the beginning and end of each videodisc segment.

Freeze Frames. The freeze frame feature allows the instructional programmer to present a videodisc segment and wait before executing the GOTO instruction. The length of the wait is determined by the programmer.

Creating Instructional Data Files

After programming forms have been completed, the information on the forms must be stored on a floppy diskette. This procedure requires the use of the Data Entry program, through which question parameter data can be entered by anyone with typing skills and some experience with floppy diskettes.

Debugging Data Files

As with all computer programming endeavors, debugging is a major activity. The authoring system contains a program to assist in the debugging process. The program scans the instruction data files and checks for the following:

- Missing GOTO values
- Too many *N* flags
- Minumum coordinate values exceeding maximum coordinate numbers
- Impossible GOTO values
- Starting frame numbers exceeding ending frame numbers

This level of debugging basically concerns syntax and missing or illegal parameters. The next level involves debugging the logic. Debugging on this level is very arduous because it involves checking every situation the student might encounter when interacting with the system and program in question. The instructional flow logic is checked, as well as the appropriateness of feedback. In addition, the accuracy of screen coordinates and frame numbers is verified. Debugging is critical to the success of the program because the student will work independently

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with the system, and thus the instructional developer cannot depend on teacher interpretation of ambiguities or errors in the system.

Collection of Student Data

The MCVD system is one of the first attempts to provide operational CAI to nonreaders. In this sense, the system is unique and there is a lack of research-based knowledge directly applicable to developing CAI for this type of student. Thus, it is necessary to collect data reflecting problems with the instructional sequencing in addition to data on student progress.

Data collection is relatively simple given the large storage capacity of the floppy disk system. Data are collected on the type of response (correct, incorrect, or nonresponse) and the time taken to respond. Past experience suggests that students using the MCVD system respond an average of eight times per minute, which generates a large amount of data. Also maintained on the student data files are the beginning and ending segment numbers for each session and the total elapsed time of the session.

Summarization of Student Data

A question and the related responses are referred to as a segment. The segment number, which is unique to each segment, identifies a particular segment, the type of segment (instruction or test question), and the overall instructional objective of which the segment is a part. Summarization is possible by objective and type of segment. The following describes four different types of summary reports available to the student, teacher, and instructional developer:

1. At the end of each session the student is presented with a graph indicating progress by objectives. The graph is presented on the monitor screen and is also available in hard copy form.
2. At the end of a session an optional hard copy graph illustrating the number of sessions per objective is also available.
3. A hard copy listing shows every response during a session, including the type of response and the time required to respond.
4. A hard copy listing summarizes progress for each student by group.

The data from each student file are transferred periodically to a larger mainframe computer for permanent storage on magnetic tape.

Student demographic data
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Field tests were condu
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Teaching Matching

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Student demographic data are also stored on these tape files. Analysis of the data can then be accomplished with statistical analysis systems such as SPSS or SAS.

Field Tests

Field tests were conducted on all six instructional programs. These field tests were conducted to (1) test the reliability of the hardware and computer programs, (2) collect data for the analysis of the instructional sequencing, (3) investigate the instructional effectiveness of the instructional programs, and (4) determine the appropriateness of using the system with severely mentally handicapped students.

Extensive data were collected and analyzed for all of the field test objectives, the results of which are available in the final report of the project (Thorkildsen, 1982). In this article we are primarily concerned with one objective in particular—formative evaluation of the instruction. One of the instructional programs, Matching Sizes, Shapes and Colors, is described for illustrative purposes.

Teaching Matching

One of the prerequisites for participation in many forms of instruction is the ability to match to a sample. Most forms of preschool assessment and instruction rely heavily on a pupil's ability to match an example with members of its respective class. Particularly with severely mentally retarded pupils, competency in matching is a prerequisite to most instructional programs. To teach the matching to sample concept, an interactive videodisc program was developed with three levels of difficulty of matching across sizes, shapes, and colors. At the simplest level was the task of identifying the one member of a group that matched the sample. The next level called for picking out the two members of a group that matched the sample, and the third level required the selection of the three members of a group that matched the sample.

Two instructional strategies were possible: In strategy one all three levels of difficulty of color matching would be taught. Next, shape matching would be taught, hopefully starting at the second level, then moving to the third level, and then moving to size matching, starting at the second or third level.

In strategy two, teaching would begin at the first level of difficulty in color, then the first level in shape, and then the first level in size. The next step would be to teach the second levels in color, shape, and size, and then the third levels in color, shape, and size.

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In keeping with the principles of lean programming, the shorter approach—the first strategy—was chosen (see Note). Six severely retarded pupils were selected, and strategy one was field tested. One of the six pupils was not able to successfully complete any of the initial instructional tasks and was dropped. The data in Figure 4 represent the pattern of pupil responses for the remaining five subjects.

The trials per lesson refers to the average number of times it was necessary to route a pupil through the criterion test at the end of the lesson. Three consecutive correct trials were necessary before the pupil could move to the next lesson. Instruction in the first sequence was terminated when the two leading pupils had reached a point of frustration.

With the aid of the authoring system, the lessons were reordered into the sequence listed on the horizontal axis in Figure 5. This sequence was an adaptation of the second strategy. The reduction that occurred in trials per session was to be expected for Level I color lessons because these lessons had been completed successfully by all pupils during the first sequence. However, no pupils had previously completed Level III lessons, nor had the pupils been exposed to Level I lessons for shape and size. One of the two leading pupils had stopped in the first sequence at Lesson 8 after 125 trials. In the second sequence, this pupil passed Lesson 8 after 14 trials. The other leading pupil had stopped in the first sequence at Lesson 9 after 74 trials. In the second sequence, this pupil successfully completed Lesson 9 after 11 trials.

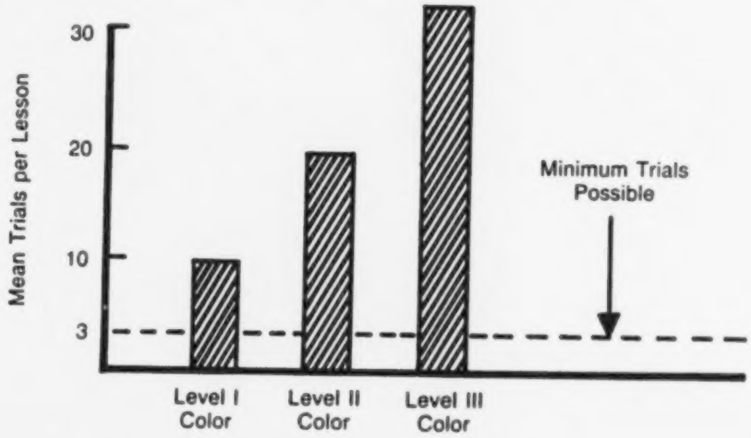

Figure 4. Trials per lesson for instructional sequence 1, Group 1.

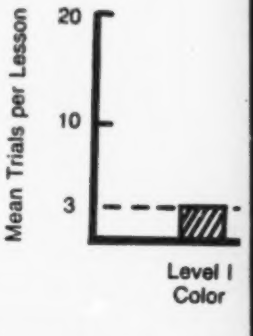

Figure 5. Trials per less

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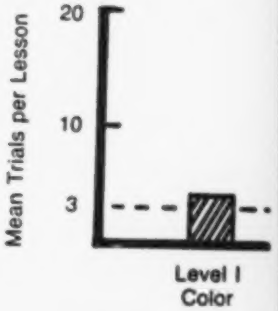

Figure 6. Trials per

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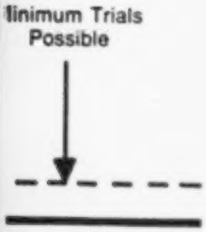

Group 1.

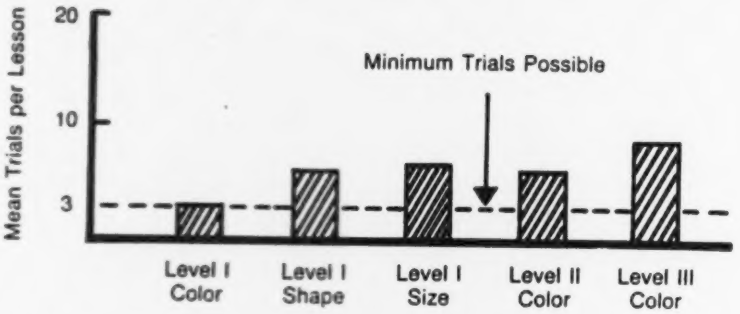

Figure 5. Trials per lesson for instructional sequence 2, Group 1.

Further replication of this program with the revised sequence and a second group offered additional support for the increased effectiveness of the second strategy. Figure 6 represents the results of a second group of five handicapped pupils.

With the aid of the authoring system, instructional sequences were quickly changed and a wealth of data was collected. This software enabled the close monitoring of progress of the group and individuals; when a weakness in the instruction was identified, the instructional sequences were rearranged.

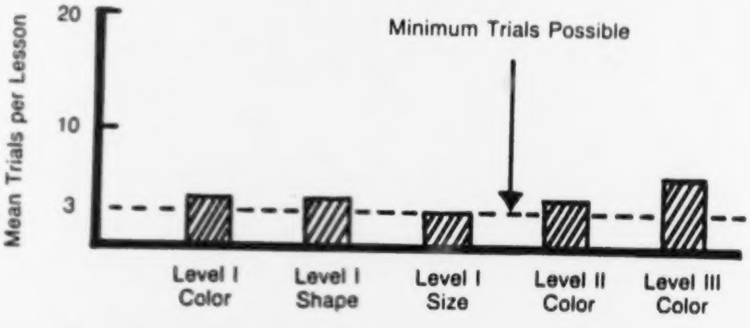

Figure 6. Trials per lesson for instructional sequence, 2 Group 2.

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Discussion

This discussion is based on the findings of the four field tests, and is organized according to the original criteria established for the authoring system.

1. The instructional programmers who developed the six instructional programs had no computer programming experience. They were able to use the authoring system and to develop the logic for the instructional sequences to build and debug the instructional data files.

2. During the instructional development process, changes were made in the authoring system to provide capabilities desired by the instructional programmers. The resulting system was sufficiently flexible to accommodate the needs of the instructional programmers for the six programs. The authoring system has reached the degree of flexibility needed for future MCVD instructional developments and is presently being used in the development of a bilingual math assessment program and a social skills training program.

3. The data collected during the field testing of the first four programs provided the information necessary to make required changes both during the field tests and after the field tests. Based on the response data collected, the Directional Prepositions and the Beginning Reading programs were developed with different remediation cycles than were included in the first four programs. One of the new programs was designed specifically to investigate different levels and the types of remediation.

4. In a field test conducted in a resource room the teacher was able to use the system after two hours of training. A prototype classroom management manual was made available to the teacher. The teacher found this manual useful in the operation of the system.

5. The resource room teacher used the graphical data supplied by the system to track student progress. These graphs were also used to reinforce the students. Now the graphical information is directly available to the student at the end of a session in the form of a thermometer graph.

In general, we found the authoring system to be valuable in developing and revising the instructional materials developed as part of the project. Based on the overall experience gained from the IVSET project, we are convinced that an interactive videodisc system with either an external or internal microcomputer has great potential for assessment, diagnosis, prescription, and instruction of handicapped

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We and other instructional developers are learning a great deal about designing instructional software for interactive videodisc systems, but additional research and development are necessary. A multitude of empirical questions concerning the effectiveness of various types of feedback, instructional sequencing, remediation procedures, branching criteria, and the general motivational aspects of an individualized teaching system awaits further research.

Note

Lean programming refers to the practice of field testing with the least expensive approach. Field test data will identify when an instructional sequence is complete. It is, however, very difficult to determine when a sequence contains superfluous material. To avoid developing materials that are unnecessarily expensive in terms of learner time or material, the least expensive approach is taken first.

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The Interactive Videodisc for Special Education Project:

Providing CAI for the Mentally Retarded

by
Ron Thorkildsen
Kim Allard
Bob Reid
IVSET Program
Utah State University
Logan, Utah

THE NEED

It is hardly surprising that the need for individualized attention increases with the severity of the handicapping condition. Yet, short of providing a teacher per student, educators of the handicapped are constantly faced with their students' educational dependence as a major obstacle to individualization within the classroom. Given the lack of independent learning skills of special needs students, teachers must search for educationally beneficial ways for students to spend their time independently as other students receive individual or small group instruction. With the evolution of the computer, the promise of Computer Assisted Instruction (CAI) to provide a vehicle for individualization became more and more apparent. However, a major problem exists when trying to use CAI with the mentally handicapped. Traditional (CAI) and individualized self-administered assessment instruments require more reading skill than most mentally handicapped students have. Consequently, it is necessary to use spoken instructions to interact with the student. The advent of videodisc players coupled with microcomputers allows educators to overcome this and other difficulties.

THE IVSET PROGRAM

The major purpose of the Interactive Videodisc for Special Education Technology (IVSET) Program is to develop and field test computer aided instruction and assessment systems for mentally handicapped students. The IVSET Program has developed hardware, software and instructional techniques which can provide both computer assisted instruction and computer aided individualized assessment for mentally handicapped students.

Three major projects have been conducted under the auspices of the IVSET Program. All three received federal funding through the Special Education Programs of the U.S. Office of Education. As part of the first project, the major hardware and computer software components were developed as well as five instructional programs. This two-year project ended in February, 1982. Two projects are currently in operation: a bilingual computer-aided assessment instrument and instructional programs that teach social skills to behaviorally handicapped students

THE IVSET INSTRUCTIONAL PROGRAMS PROJECT

A major objective of this project was to develop a microcomputer/videodisc (MCVD) system. The hardware for the MCVD system consists of a Pioneer Model 7820-III Videodisc player, an Apple II Plus microcomputer with two 5¼" floppy disk drives, a Sony 12" color monitor and a Carroll Mfg. touch panel built into the monitor. The videodisc player was selected for its rapid, random access capabilities and excellent still frame quality. (A typical search and retrieval of an instruction or feedback segment takes less than 1 second.) The touch panel is a light interrupt system that allows the student to interact nonverbally with the system simply by touching the monitor screen. The Apple II controls the system through computer programs and an interface device (Allen VMI Board). Both were designed and developed by IVSET Program staff. The videodisc is the storage medium. It is the approximate size and appearance of an LP phonograph record, and can store 54,000 individual frames of video or 30 minutes of audio and motion video on each side. It also has two independent audio tracks.

After seeing and hearing some material, the student responds by touching the appropriate image of an object on the monitor screen. When the student touches the screen, two light beams transmitted from each axis of the touch panel are interrupted, and the point of interruption is detected by the touch panel. The X and Y coordinates are then transmitted to the computer. The computer program in the microcomputer contains the correct coordinates for each segment of instruction. The coordinates transmitted by the touch panel are compared to these correct coordinates.

After a correct response, the microcomputer responds by finding and retrieving a segment on the videodisc which contains an audio and visual positive

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feedback. Other possible response conditions are an incorrect response and a non-response. Segments are present on the videodisc for these response conditions as well as a variety of feedback, including animation and motion picture sequences.

Each segment of instruction has associated parameters that specify the number of times a student must respond correctly to advance to the next instruction segment. As the student responds, the system stores data on a floppy disk.

The first project developed and field tested five instructional programs for use with the MCVD system: (1) Time Telling, (2) Identification of Coins, (3) Functional Words, (4) Sight Reading and (5) Directional Prepositions.

The major goal of all field tests was to facilitate continuing development and refinement of the system. The tests generated data for these research questions:

1. How effective are the instructional programs and how effective is the system with different levels of mentally retarded students?
2. How effective is the system for providing motivational feedback?
3. What procedures are required for implementing the MCVD system in the classroom?
4. How cost effective will this system or a similar system be in a classroom situation?

Each separate field test was also guided by research questions specific to the population and the instructional package involved.

Resource Room Field Test

One of the field tests was conducted in a resource room in Logan, Utah between April 1 and May 15, 1981. The major purpose of this field test was to obtain data concerning teacher use of the system. The field test at the Training School was conducted by IVSET Project staff and did not involve teachers independent of the project. The resource room teacher was responsible for conducting the field test, and an IVSET Project staff member collected extensive data for use in the refinement of a classroom management manual. The resource room teacher was able to use the system after one hour of training. A prototype classroom management manual was made available to the teacher during the course of the field test. The teacher found the manual useful in operating the system but made numerous suggestions for improvement.

Four first and second grade students were involved in this study. Three were classified as learning disabled and one as mildly retarded. The average WISC-R score for the four students was 82. All four students completed the Time Telling program within the six-week period. Pretest results indicated that none of the four students could tell time before starting the program.

Conclusions of current interest from the first field test include:

1. *Instructional Development.* One of the most significant findings from the field testing and production processes was the capacity of the MCVD system to provide information for instructional improvement. Since data is collected with each response from the student, a very detailed account of the instructional process is maintained. These response data can help pinpoint problem areas with instructional sequencing as well as provide information on the effectiveness of the reinforcement. This diagnostic process was used a number of times during the present project to revise sequencing of three of the programs.

At present we can modify the instructional logic quite readily through the use of the authoring system developed by IVSET staff, but of course we cannot change or add to the contents of the videodisc. When read/write videodiscs become available, this limitation will be removed, and a system such as the MCVD system with the addition of a videodisc recorder will provide an instructional developer with an extremely powerful instructional development system.

2. *Populations.* The following populations were involved in the field testing of the MCVD system and programs:

a. Elderly Mentally Retarded
   —Brigham City Day Care Center.
b. Young (4-13 yrs.) severe to moderately mentally retarded
   —Excpt. Child cntr.—Matching
   —Excpt. Child cntr.—Prep.
c. All age severe to moderately mentally retarded
   —Utah State Training School
d. Young (7-9 yrs.) learning disabled and mildly mentally retarded.
   —Resource Room—Time Telling
   —Resource Room—Beg. Reading

Investigation of different populations was conducted both to determine if the students learned from using the system and how independently the system functioned. A major development goal is to have the system as independent of the teacher as possible.

The system was least effective with the young (4-13) severe to moderately mentally retarded students. Both the Matching and Prepositions field test required a great deal of teacher intervention to keep students on task. This varied a great deal among children, but in general the system could not be classified as working independently with the child.

The system was most effective with Learning Disabled and Mildly Mentally Retarded (also referred to as EMR) students. The students completed the Time Telling and Beginning Reading programs with little or no teacher intervention. As part of the management plan in the Beginning Reading field test, sixth grade students helped the Resource Room students get started with

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the system. This almost completely eliminated the need for teacher intervention. The MCVD system functioned independently with this population.

3. *System Reliability.* Reliability of the system was a problem during the Training School field tests. A system failure occurred, on the average, twice a day for the entire field test. The Apple II system, touch panel, monitor and videodisc player were very reliable. Most of the bugs in the weak parts of the system were located and eliminated and breakdown averaged one every other day during the next field test. During the final two field tests, two systems operated for a total of twenty days without a breakdown. The system in its present form is very reliable.

4. *Cost Effectiveness.* At current prices, the cost of purchasing and operating an MCVD system over a three-year period is:

a. Pioneer 7820-III Videodisc Player	$2500.
b. Apple II Plus, dual disk drives, 48K and Language Card	2400.
c. Printer and Printer Card	800.
d. Touch Panel and Installation	1500.
e. Color Monitor	700.
Total Purchase Cost	$7900.

Over a three-year period using an interest rate of 12% per annum, the yearly purchase cost of equipment would be $3700. Annual maintenance charges are about $485 and supplies about $200 per year. Thus, the estimated total yearly cost is $4385.

The cost of a teacher could be used for comparison purposes, but in general a trained aide could conduct typical MCVD instruction. Therefore, the cost of an aide would make the most useful comparison.

Any cost comparisons involving microelectronics hardware is timebound. Over time, the cost of labor essentially remains stable, while the cost of hardware will continue to decrease. Furthermore, videodisc players are becoming more powerful as stand-alone devices. Increasingly powerful microprocessors in them provide for interactive use without need for an external computer. The math and social skills projects utilized this option.

5. Data gathered from the first project substantially aided research and development efforts during the two current projects, Math Assessment and Social Studies.

THE IVSET MATH ASSESSMENT PROJECT

The IVSET Math Assessment program was designed to be a criterion-referenced measure of the math skills of students whose ability lies between grades 1 and 3. The test will also yield a grade equivalent score. The teacher can choose to administer the test in English or Spanish. The use of the videodisc allows this because two audio tracks can be created for each question. In some areas this could be the only means available for obtaining a valid representation of a student's functional level.

The IVSET Math Assessment Program provides a unique testing environment. The test is administered verbally, making it a measure of mathematical ability instead of reading ability or ability to follow directions. This is especially important in the case of learning disabled persons who may have a wide discrepancy between reading and mathematical ability. Since it is criterion-referenced, it provides a profile of a student's mastery of skills instead of merely a grade equivalent score. This allows the teacher to focus instruction or remediation on weaknesses the test has pinpointed. In addition, the Math Assessment disk reduces cultural test bias by presenting the test verbally in the language most appropriate for the student.

Two equivalent forms of the test contain 408 criterion-referenced questions each. Test questions consist of a graphic and an audio segment. All qustions are multiple choice or true/false, so no constructed responses are required. The test is divided into seven "strands," each strand covering a mathematical concept or skill area. Problems in each strand are presented in ascending order of difficulty. Each strand is further divided into sections which contain subgroups of skills.

When the test is administered, students start with the first question in the first section of a strand. Teachers can select any start strand. Test questions in a section are administered until a student makes three consecutive errors. When a student misses three consecutive questions, s/he is branched to the next section in the strand. When all sections in a strand have been completed in this manner, the next strand is presented or the program branches back to a menu.

Teachers have two methods of administering the test. If the teacher desires to give a complete assessment and test every area, the system will automatically administer the entire test (and even call the teacher when it is time to turn over the disk). If a teacher only wishes to check a particular area, the system allows the user to select the particular strand and section desired, administer it and return to a main menu. The student or teacher can exit the system at any time.

The IVSET Math Assessment program uses two separate systems to deliver the test, the "Full System" and the "Stand Alone System." These systems use the same disc but are separate and distinct delivery systems.

The Full System is essentially the same system previously discussed in the description of the first project. It automatically tracks student progress through the test, records responses, provides for report generation of student results, processes information and does error analysis of students' incorrect responses. Error analysis is performed upon selected questions which involve computation by the student. Each of the multiple choice distractors was constructed to represent a particular computation error. The teacher can use this to diagnose a pattern of errors. The computer automatically records the number of errors of a particular type the student makes and the number of times the student could have made the error. This allows the

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teacher to determine whether multiple errors of the same type were coincidental or represent a pattern.

The Stand Alone System uses only a videodisc player, monitor and printer. Test presentation is identical in both systems. The Stand Alone System uses the Remote Control Unit (RCU) to enter student responses. It uses the built-in microprocessor in the videodisc player to control the test administration. The programs that control the player are on the disc itself. The player reads these programs, which allows the Stand Alone system continually to reprogram itself. The Stand Alone System also provides the user a printout of test results if desired.

The Math Assessment program will be field tested in videotape form in March 1983. After revisions, the videodisc will be produced and field tested in the fall of 1983.

THE IVSET SOCIAL SKILLS PROJECT

The social skills instructional program is being developed to teach social skills to 8-11 year old emotionally disturbed children. The program consists of about four videodisc sides and comprehensive written support materials including teacher management materials. The instructional program deals with cooperative interaction and is divided into seven components or clusters:

1. Getting Involved
2. Being Involved
3. Consolidation of Getting Involved and Being Involved
4. Ending Positively
5. Consolidation of Getting Involved, Being Involved and Ending Positively
6. Being Positive
7. Final Review

Each cluster provides the student with instruction in the rules to be followed for each skill, discrimination training using examples and non-examples, and reviews of the previous lessons. The consolidation components (3 and 5) are cumulative reviews. Consolidations are incorporated after each new skill has been presented to emphasize the need for combining the various skills together to achieve cooperative interaction.

A training component is being designed for the teacher/user. This component will include information specific to the Cooperative Interaction package as well as general behavior management concepts including praise and correction procedures. Guidelines for incorporating the program into existing behavior management programs as well as direction for establishing a unique behavior management system will be addressed in the written documentation.

The videodisc medium is used to present examples and non-examples of appropriate social behaviors as well as to present situations that prompt rehearsal and role playing activities. It is designed for use by a small group or an individual, which facilitates teacher management of the system as well as allowing for individual remedial work.

The videodisc program is being designed to use a Stand Alone System as described in the description of the Math Project. Consequently, no external microcomputer will be necessary to achieve interactivity. As with the Math Assessment program, the student and/or teacher interacts with the system using the remote control unit (RCU) of the videodisc player. The RCU is masked to eliminate use of some of the keys and to designate special-purpose keys.

Both the math and social skills programs will be field tested on videotape before the videodiscs are produced. A random access videotape player is used for this purpose. An interface board was designed by project staff which allows the microcomputer to control the videotape player. The instructional programmer writes the same instructional program for either the videotape player or the videodisc player. The computer software and the interface card takes care of the transition between players. This greatly facilitates the revision process.

The Social Skills program will be field tested using videotape in April, 1983, and the videodisc version will be field tested in the Fall of 1983.

CONCLUSIONS

The major purpose of the first project was to explore the feasibility of using a microcomputer/videodisc system to provide computer assisted instruction for mentally handicapped students. A great deal was learned concerning use of the hardware, instructional design with interactive video and videodisc production techniques. Information concerning the project has been widely disseminated through national presentations, publications and the final report.

The design of the programs now in development is based heavily on the experience gained during the first project. We expect to produce validated and reliable products for use in schools. Both programs will be available for use with the Stand Alone System, which greatly reduces the cost. The videodisc player and printer can be purchased for approximately $2,700. It is expected that similar equipment will be available within two years for approximately $1,200.

Based on the experiences gained from all our projects, we are convinced that an interactive videodisc system with either an external or internal microcomputer has great potential for assessment, diagnosis, prescription and instruction of handicapped and normal students. Videodisc and microcomputer technology is rapidly improving and decreasing in cost. We and other researchers are learning a great deal about designing instructional software for interactive videodisc systems, but a great deal of research is still necessary. There are a multitude of empirical questions concerning the effectiveness of various types of feedback, instructional sequencing, remediation procedures, branching criteria and the general motivational aspects of an individualized teaching system. END■

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Math Assessment Videodisc Program

(In preparation for submission to The Computing Teacher)

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Abstract Assessment of student skills in basic subjects is particularly difficult in the elementary grades and with the mentally retarded and the learning disabled because of the reading and writing skills associated with many tests. As part of a two year research and development grant the Interactive Videodisc for Special Education Technology (IVSET) Project developed an interactive videodisc system for assessment. This article deals with the math assessment videodisc produced by IVSET. This program incorporates bilingual criterion-referenced testing for grades one to three and detailed report capabilities. The article also discusses the potential of interactive videodisc systems for instructional delivery and testing.

Introduction

In order to deliver effective instruction, it is imperative to evaluate student abilities and skill deficiencies through testing. In the early elementary grades this assessment often takes the form of a pencil and paper test which students complete and teachers score manually. There are several limitations, however, to traditional methods of testing. For students, these tests may mean struggling with problems which are too difficult, wasting time with problems which are too simple, understanding written instructions which are harder to follow than the test items themselves, or comprehending instructions in a second language in which they are not totally familiar. From the teacher's perspective, the time and tedium involved in administration and scoring means more work.

Computer-Assisted Testing With the advent of computers, the testing process promises to become more relevant to students and yield higher quality data for teachers. Testing can be delivered in an individualized, interactive mode. Based on student responses to test items, the program can center the bulk of the test on items which are neither too easy or difficult for the student, providing a microscopic view of abilities and deficiencies. Computer-assisted

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testing programs quickly perform the scoring, conversion, and error analysis tasks that can require so much teacher time and effort. A major difficulty with computerized testing, however, is that reading skills are still required. For instance, in assessing math skills, the ability to read and comprehend screen directions may have a stronger relation to student achievement than computational ability. This may be a particularly important factor with the learning disabled whose math and reading abilities often are dramatically different.

Interactive Videodisc The interactive videodisc exploits the advantages of computer-assisted testing while overcoming many of the limitations of the computer medium. It accomplishes this by presenting tests through the familiar spoken word and video of television while retaining the computer features of individualization and interactivity. Because the videodisc player can quickly access any audio-visual segment of a thirty minute disc, it can be interfaced with a computer for control of testing. A computer program assesses the learner's responses and manipulates the videodisc, branching to appropriate sequences on the disc without noticable pauses in testing flow.

The videodisc can be played linearly, forward or reverse, for motion or audio segments or can display still frames one at a time in any order. There are three types of videodisc systems: 1) Level I - these are videodisc systems without programable capabilities; 2) Level II - these are videodisc systems which use a microprocessor built into the player to branch using a computer program stored on the videodisc itself, and 3) Level III - these are systems which interface with a microcomputer for program control. The Math Assessment Videodisc, discussed in this article, can be used in either a Level II or Level III system by using the internal microprocessor or the external computer to operate a program for branching and control of the disc.

IVSET Math Assessment Videodisc

Overview The Math Assessment Videodisc, developed by the Interactive Videodisc in Special Education Technology (IVSET) Project at Utah State University, one of several videodisc programs developed through funding from the Office of Special Education at the United States Department of Education, is produced for use with regular and special education students. The program is designed to conduct individualized criterion-referenced testing of students whose functional math skill level is between first and third grade. The system tests students by presenting questions and instructions in either of two languages, English or Spanish. The system also prints a variety of reports after assessment.

Hardware Options The Math Assessment Videodisc operates on one of two hardware configurations: 1) a Level II system - consisting of the videodisc player (Pioneer PR 7820-3), a remote control unit, a color television, and a modified Epson printer, and 2) a Level III system - consisting of an Apple II microcomputer, two disk drives, printer, videodisc player, and color television. The Level II system uses a computer program stored on the videodisc itself. It has the advantage of using less hardware and is therefore less expensive to operate, but it has limited storage and reporting capabilities. The videodisc and teacher's manual for the Level II system sell for $195.00. The Level III system uses software stored on four floppy diskettes for test administration, student data management, and reporting purposes. With this system, the user can enter student rosters onto diskette, monitor testing for each student, store test results to diskette, and print out several more reports. The videodisc, teacher's manuals for both Level II and III systems, and software for the Level

III system cost $295.00. The Math Assessment Videodisc is commercially available through Systems Impact, Inc., 2084 N. 1200 E., Logan, UT 84321.

Content The Math Assessment Videodisc tests math competencies in seven separate areas, called strands. These are: numeration, whole numbers, fractions, decimals, measurement, geometry, and graphing/prediction. Each strand is divided into sections which contain related objectives. In total, the program assesses math in three hundred and thirty-five separate objectives. A scope and sequence of all of the objectives is included in the teacher's manual. Because all directions and questions are presented verbally, the videodisc reduces or eliminates the error associated with interpreting written instructions or of failure to comprehend instructions presented in another language.

Pre-assessment Activities The teacher is advised to become acquainted with the videodisc so that she or he can instruct pupils on use of the system before any assessment takes place. A step-by-step tutorial, included with the manual, serves this purpose. The training session with the student consists basically of the teacher displaying pictures of the screen and keyboard and having the student react to them as if he or she were in a testing session. This helps the child overcome any anxiety associated with the equipment while teaching necessary skills for taking the test.

The teacher should be sure that students possess the necessary prerequisite skills to use the Math Assessment Videodisc. First, students must be able to comprehend spoken directions at the first grade level in either Spanish or English. Second, they must be able to attend to task for a consecutive period of ten to twenty minutes. They must be able to recognize and discriminate the letters, A, B, C, and D in printed form. In addition, they must have the perceptual skills to see figures and numbers visually on a television screen, and be able to indicate the response they select by either speaking it aloud, by touching an area on the television screen, or by typing a letter on the computer.

Program Interaction The teacher selects the language for assessment, the strand and section to start the test with, and then signals the system to begin by depressing the appropriate key on the computer or the remote control device. The program branches to the designated segment and assessment begins. A short segment introduces the concept to be tested with a cartoon elephant named Elmo. This elephant appears before test sections to establish student expectations and help maintain continuity and interest throughout the test. A typical question format displays a math problem in picture form while the audio presents a test item. The lower portion of the screen displays three or four boxes with possible answers the student can pick from. While taking the test, students may use paper and pencil to calculate their answer, but they indicate their selection by touching the box on the screen or by saying the letter aloud. The teacher or aide then enters their choice at the computer keyboard or with the remote control device and the videodisc advances to the next segment. Some students, with training, can enter their answers independently of the teacher and take the test without any supervision. Because this is an assessment program, there is no feedback as to whether the student's response is correct or incorrect; however, all student responses are stored on floppy disk or printed out when the session is completed so that the teacher can have a record of student work. The child can have a question repeated once by depressing the space bar on the computer or repeat button on the remote control device. After the child has selected an answer, the program presents the next problem and the process repeats itself. The videodisc system also advances automatically to the next question if no response is entered after sixty seconds. This question-response process continues through the section or strand the teacher has selected, until the student enters three consecutive incorrect answers, or is terminated by the instructor. At this point the testing session terminates if just one section has been choosen for testing, otherwise the videodisc jumps ahead to the the next section in the strand.

The time required to take the entire test ranges from about one and a half hours, for students functioning at the first grade level, to four hours, when administered to students functioning at a third grade level. However, it is not recommended that teachers administer the whole test at one time. The test should be divided into several sessions, depending on the pupil's ability, attention span, and which sections are presented.

Reports After the appropriate parts of the test have been given, sometimes spanning a period of several days, teachers can produce a complete student math profile using the reports generated by the system. There are four types of reports available with math videodisc system: 1) objective mastery reports which present student progress towards each of the objectives tested, 2) student summary reports which give an overall view of student mastery on the whole test, 3) error analysis reports which identify patterns of computational errors learners made consistently during the test, and 4) student progress graphs which display success in all seven strands in bar graph form on the screen. The Level II system prints only the objective mastery report.

Using Student Scores Besides the amount of information available to teachers from these reports generated after one assessment, the Math Assessment Videodisc can be employed during and after instruction. After the initial pretest, the videodisc assessment can be administered as a posttest to measure functional gains or losses by objectives mastered, or teachers can compute the percent of mastery by grade level. The manual which accompanies the Math Assessment Videodisc suggests that more emphasis be placed on the overall achievement in the strand than on scores for each individual objective because there is only one item per objective, and there is an inherent chance factor with multiple choice items. Instruction should begin at the place that correct and incorrect answers appear equally and not necessarily where the test was terminated. However, all instructional decisions should be made by the teacher; all the test scores can do is indicate appropriate areas for instruction or further testing.

Field-testing Producing a videodisc is similar in some ways to making a record. Just as a record is created from a tape recording and cannot be changed once it is pressed, the videodisc is converted from a videotape recording and cannot be altered once it is produced. Because of the costs involved in mastering a videodisc and the fact that its content cannot be changed once it is created, the videotaped version of the Math Assessment Videodisc underwent rigorous testing to eliminate errors before being converted to videodisc format. This fieldtesting progressed through several stages: the items were first tried in graphic form with learners; next, students during in-house trials used a videotape player interfaced with a microcomputer to simulate videodisc assessment; and sixty-one individuals in three fieldtest sites used the videotape independently of project staff. The data collected from these fieldtests were used for making revisions on the master videotape prior to its conversion to videodisc.

Conclusions

What are the educational implications of this product? The Math Assessment Videodisc represents a unique medium for testing students on an individual basis. Because videodiscs are becoming more popular and widespread in a variety of training settings such as the military, medicine, business, and industry, there is good reason to believe that the same trend will emerge in education. As videodisc hardware becomes less expensive and more available in school settings, assessment using interactive videodisc should increase for the following reasons: 1) it promises to be a more accurate way of testing student abilities without the confounding variables of reading prerequisites and primary language bias coming into play; 2) tests can be used throughout the instructional process for assessment of gains and losses, pre and post-test levels, etc., and 3) the comprehensive reporting and analysis features of the program free up teacher time for instruction while generating information that will make teaching more effective. The fact that the Math Assessment Videodisc is a criterion-referenced testing system is especially important in special education because students are measured according to what skills they have acquired and are deficient in and not on a comparison basis with other students. The mastery approach of the Math Assessment Videodisc focuses the whole instructional process towards achievement of specific math skills. The incorporation of the mastery approach to learning and the use of criterion-referenced tests in new interactive technologies is a trend which holds great promise for the delivery of instruction in special and regular education.

THE INFLUENCE OF TEST ADMINISTRATION LANGUAGE ON THE MATH TEST SCORES OF BILINGUAL HISPANIC CHILDREN

by

S. G. Friedman

A dissertation proposal submitted in partial
fullfillment of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

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Logan, Utah

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STATEMENT OF THE PROBLEM

The overrepresentation of Mexican-American children in special education classes has been well documented over the last decade (Bernal, 1972; Bryen, 1974; Gonzalez, 1973; Mercer, 1973; Samunda, 1975). Consequently, the validity of standardized intellectual and academic assessment, the basis for special education placement, has been questioned for these linquistically different children. Clearly, to validly assess Mexican-American children, we must reliably discriminate between cognitive-skill deficits and English language deficits (Bryen, 1974).

In 1975, with the enactment of Public Law 94-142, assessment practices for linquistically different children received federal legislative attention. P.L. 94-142, under the component of nondiscriminatory assessment, mandates that testing for the purpose of special education placement must be conducted in the child's native language. While the intent of this mandate is laudable, there is reason to question whether so simplistic a solution will ensure nonlanguage-biased test scores or appropriate educational placement.

Mexican-American bilingual children are a heterogeneous group with respect to their Spanish and English use (Horn, 1981). Their language proficiency varies along two continua, one for each language, with each child falling at any point on either continuum (Weffer, 1982). While some Hispanic children may perform better in Spanish, others may perform better in English. It cannot be assumed that the language a child learned first or speaks at home is necessarily the language that will yield the most valid results. Indeed, the findings of many studies challenge this assumption.

Twenty empirical studies (see Review of Literature section) were located in which Hispanic children were administered standardized tests in Spanish and English. The test scores were then compared. An analysis of these studies revealed widely discrepant results: eight investigators concluded that testing in English was most appropriate; three investigators concluded that testing in Spanish increased scores; one suggested using both languages for each item; another suggested English for some types of items and Spanish for other items; seven researchers concluded that the language used when testing Spanish/English bilingual children makes no difference. It appears from this review that research has yet to provide the evidence needed to determine the best administration language for testing bilingual children.

Unfortunately, serious methodological weaknesses threaten the validity of most of the studies referred to above. The language dominance of the subjects and their proficiency in Spanish and English were not considered in many of these studies; the appropriateness of the test translations and the socioeconomic status of the subjects were not typically documented; and the confounding effects of design strategies were not often analyzed (e.g., language order and repeated testing in those studies in which each subject received a test in both English and Spanish).

These factors may account for the discrepant results found in the literature. More importantly, they may provide the information needed to guide decisions about the appropriate language in which to test a bilingual child.

The literature on test administration language for Spanish/English bilingual children may be further limited by the restricted variety of tests used in these studies. In 17 of the 20 studies reviewed, intelligence tests were used. The findings from these tests may not generalize to tests designed for more comprehensive assessment of particular skill areas such as criterion-referenced tests. No studies were located measuring the effects of language on tests used for criterion-referenced purposes.

The effect of test administration language may also differ depending on the specific content being tested. Concepts involved in mathematics, for example, may not be as language dependent as concepts involved in other areas (Coffland & Cuevas, 1979). Research focused on specific academic skill areas ought to be included in the investigation of test administration language for bilingual children.

The major problem addressed in this proposal is, then, the lack of methodologically sound research to assist in determining the appropriate testing language for bilingual Spanish/English speaking children. This problem is especially important in light of the federal law which mandates testing in the child's native language.

RESEARCH QUESTIONS

1. Which language, Spanish or English, will result in the highest score on a criterion-referenced math assessment instrument administered to Spanish/English bilingual children?

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2. What is the relationship between math test scores in each language and standardized measures of Spanish and English language proficiency?

3. What is the relationship between math test scores in each language and informal teacher ratings of language proficiency?

4. What is the relationship between math test scores in each language and informal student self-report ratings of language proficiency?